CHEMICAL & METALLURGICAL ENGINEERING

VOLUME FORTY-TWO NUMBER TWELVE

DECEMBER, 1935

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WAIT—and WATCH

NOT that we're superstitious, but for another and better reason, the Thirteenth Annual Review and Statistical issue of *Chem. & Met.* will be published in February rather than in January, 1936. Too often in the past the editors have found themselves caught in the snarl of year-end business activities which made the job extremely difficult both for themselves and for the contributors on whom they must rely. A few weeks should also make a tremendous difference in the accuracy of the trade estimates and statistical information which is grist for the editorial mill. All in all, it looks like an experiment quite worth the trying.

SOMETHING more than soporific statistics is in store for the readers of this big February issue. It will be built around a vital editorial theme that touches on every field of chemical engineering interest and endeavor—"The Life Cycle of a New Product in the Process Industries." A valuable editorial supplement and check-list is in the making. It will be worth your waiting until—

February for the Thirteenth Annual Review and Statistical Number of "Chem. & Met."

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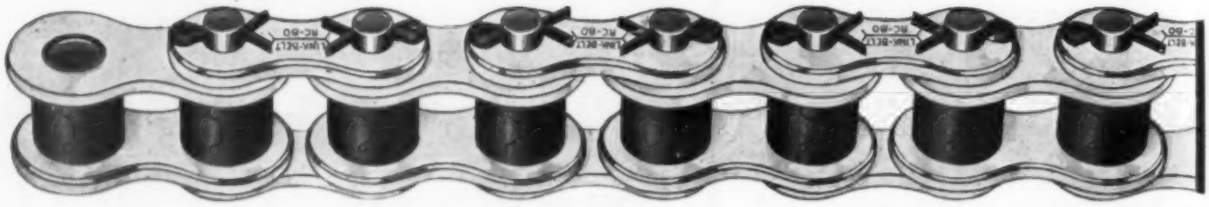

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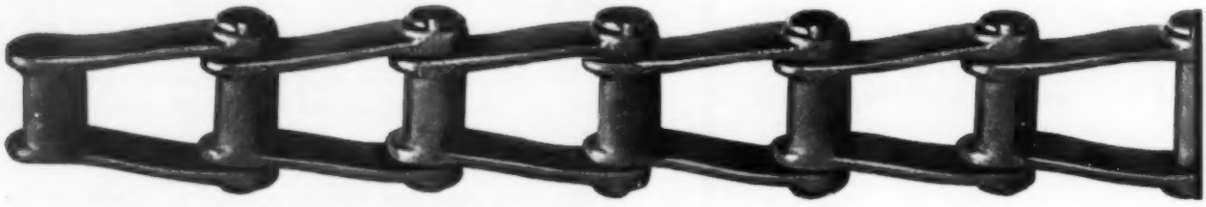

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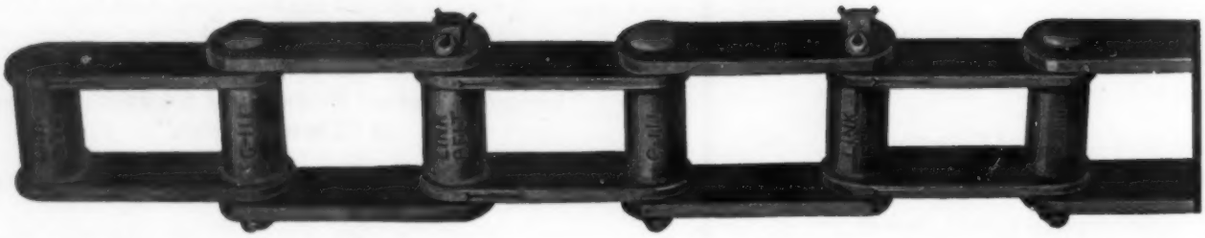

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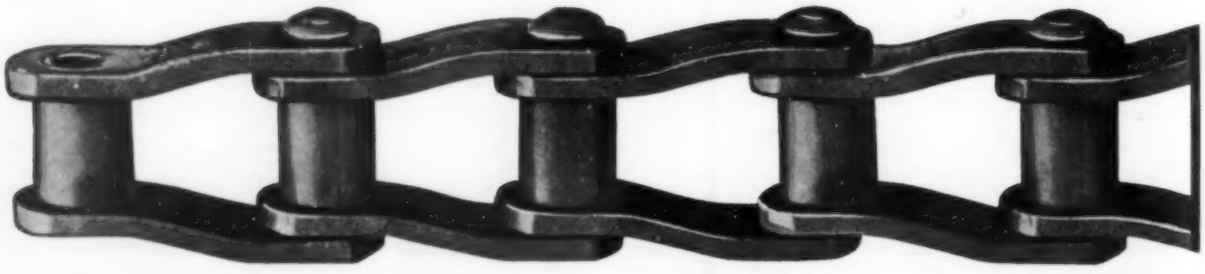

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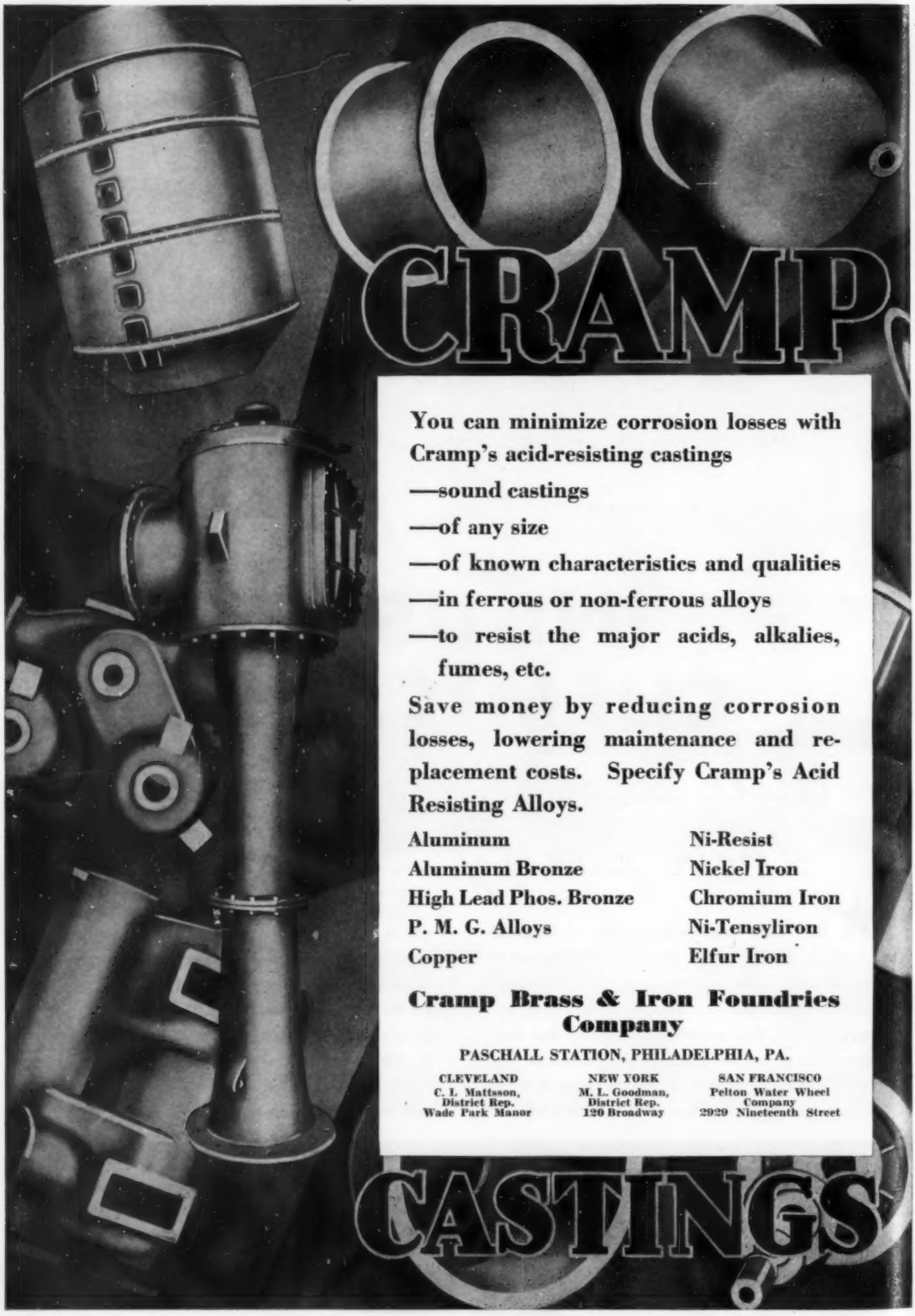

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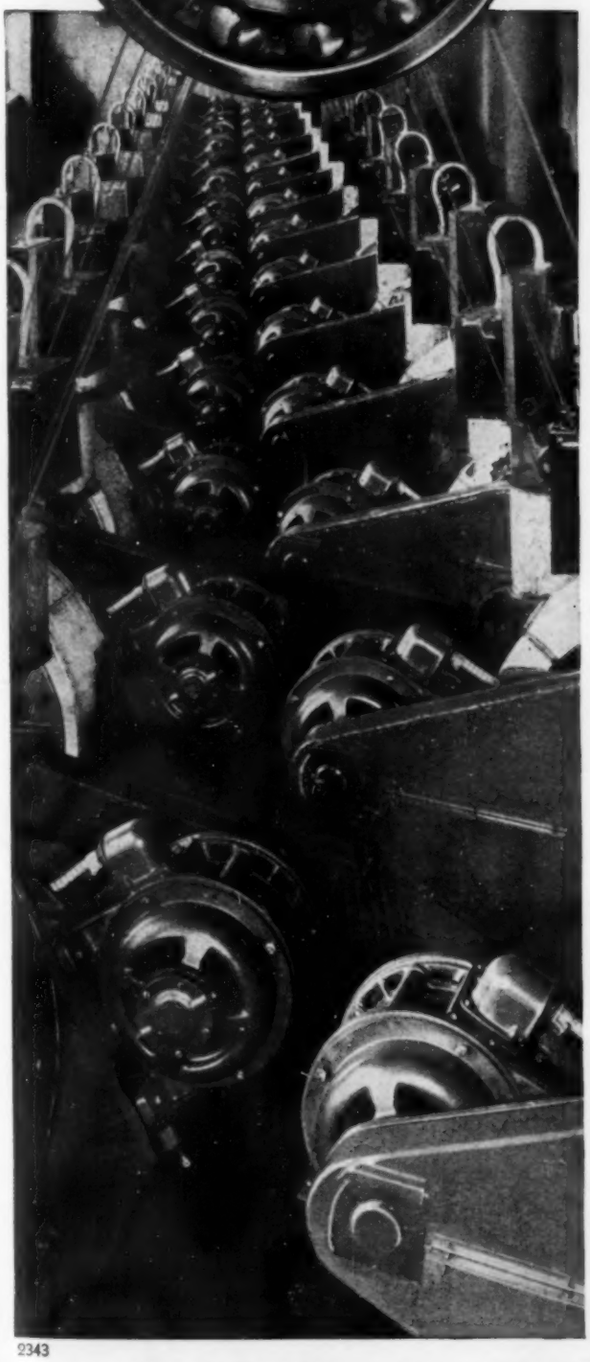

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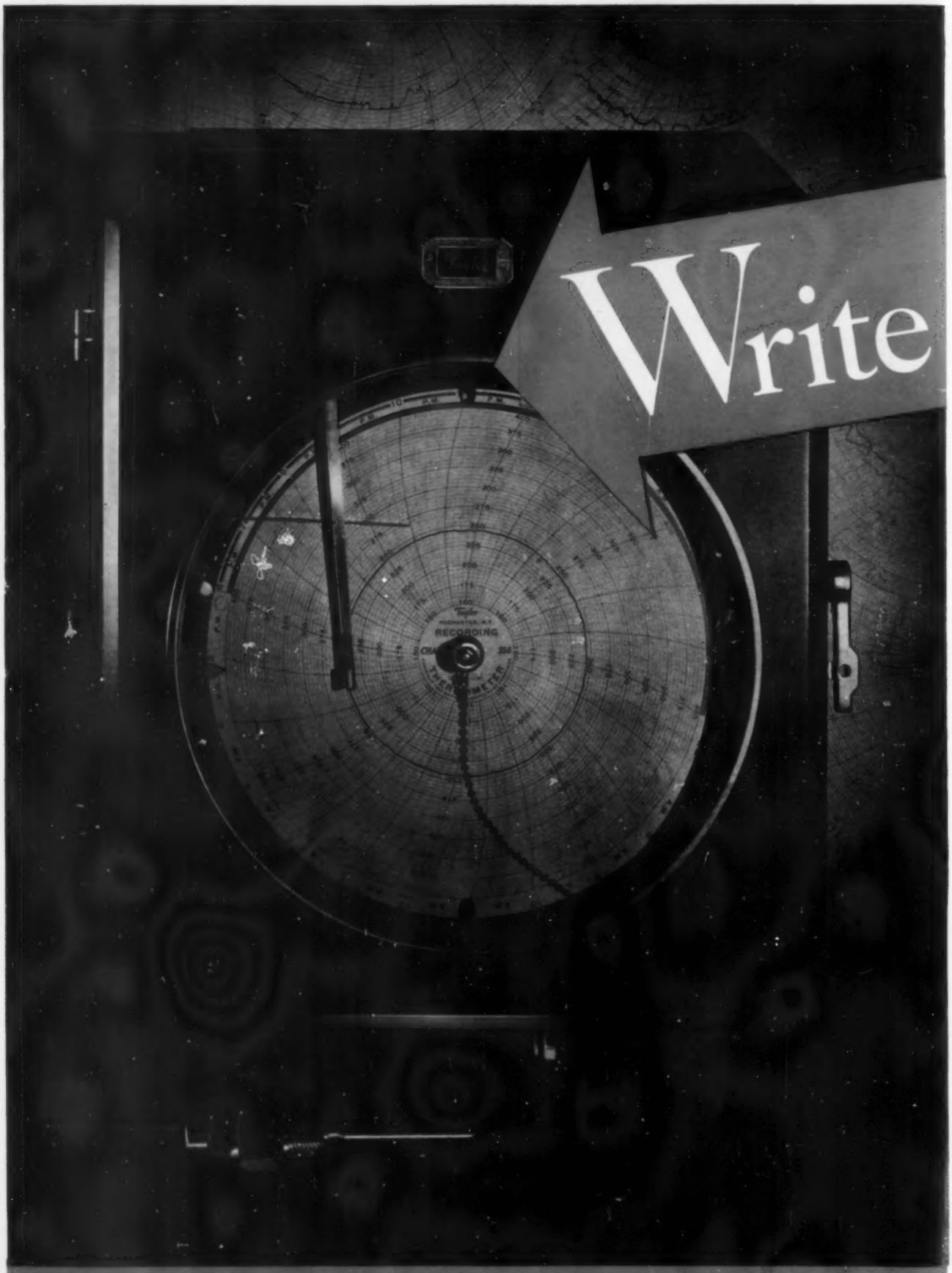

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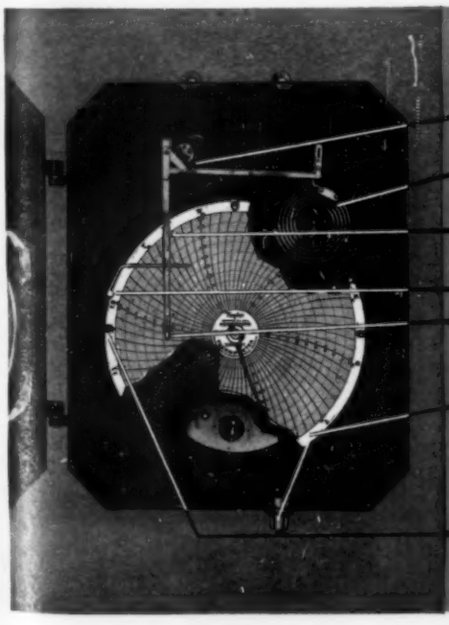

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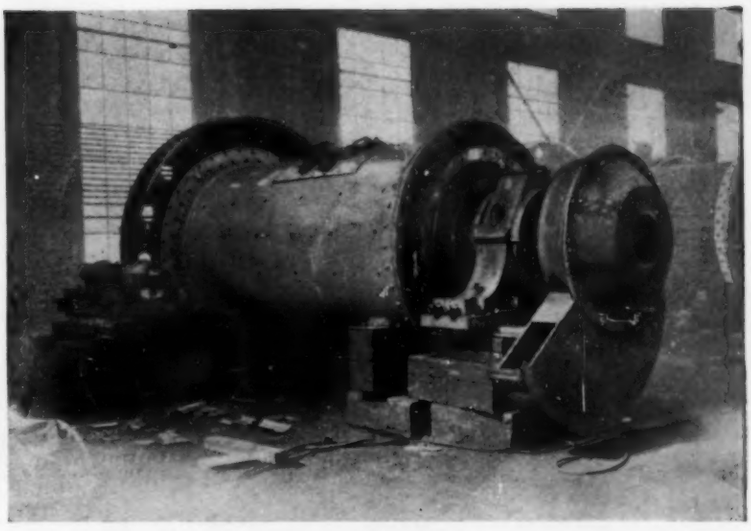

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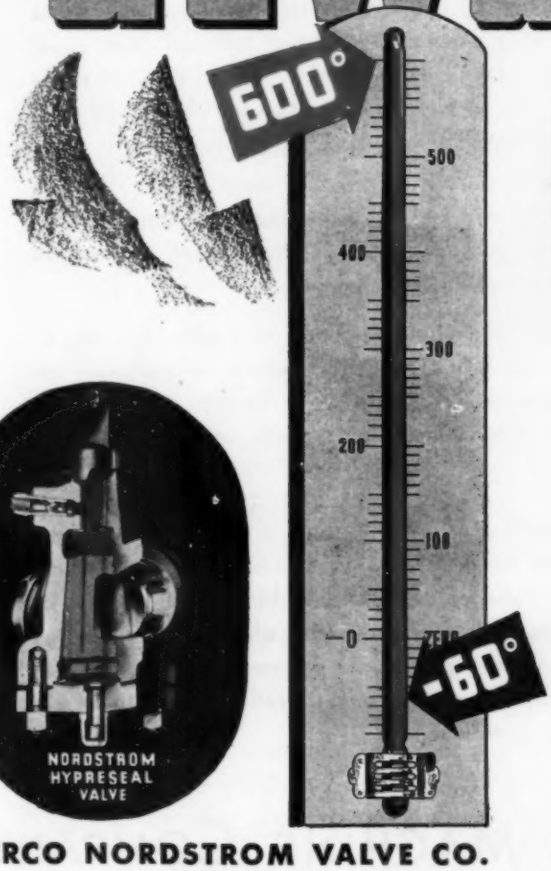

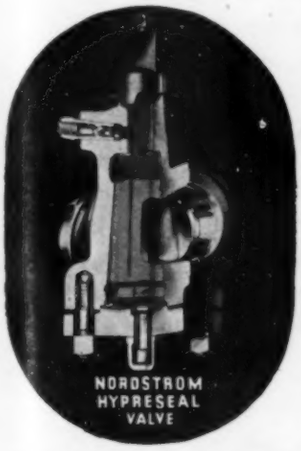

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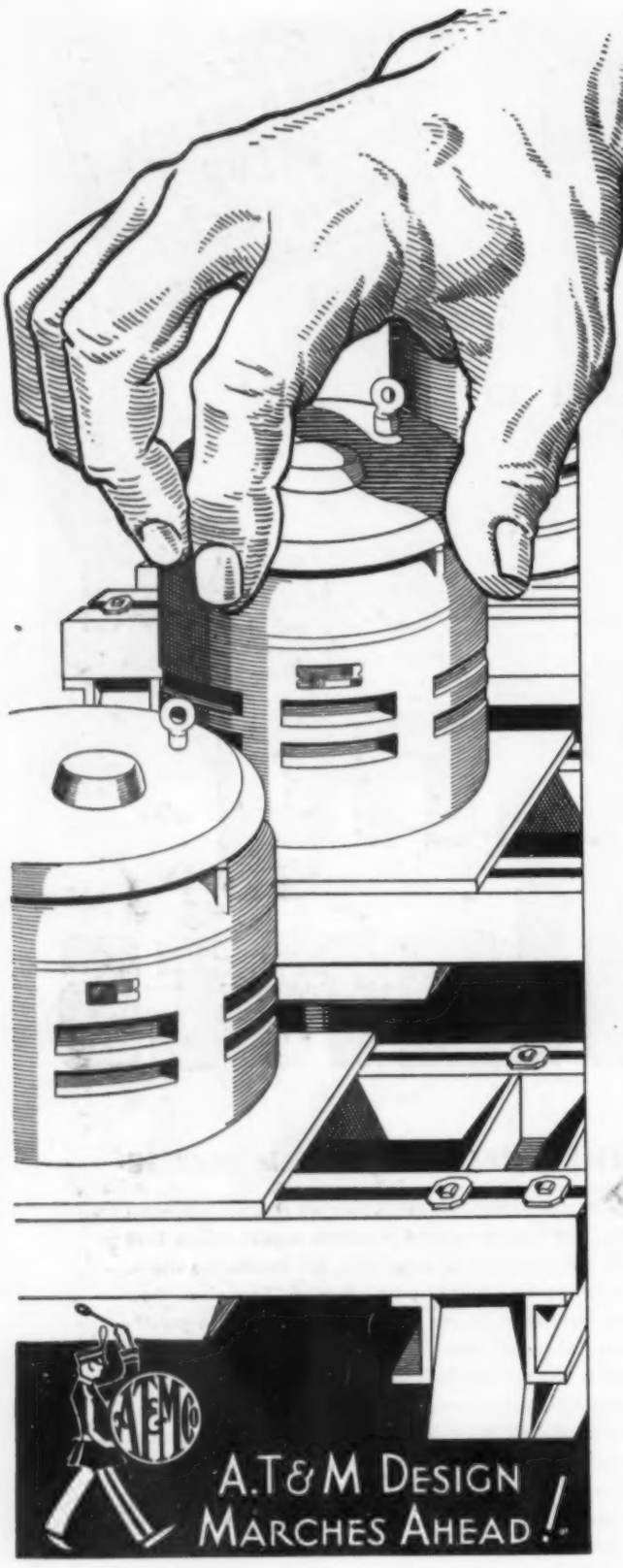

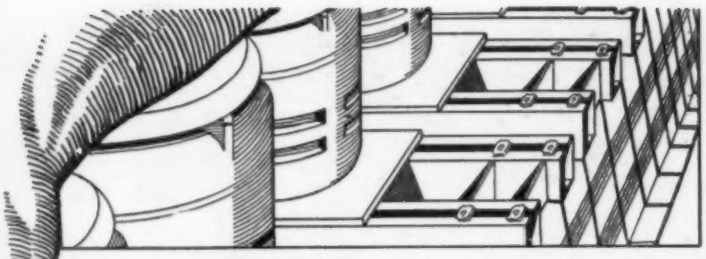

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Further investigation also found that a method of separating a suspension by settling could be profitably replaced with a centrifugal using an imperforate basket. Result: time saved and earnings of the department stepped up.

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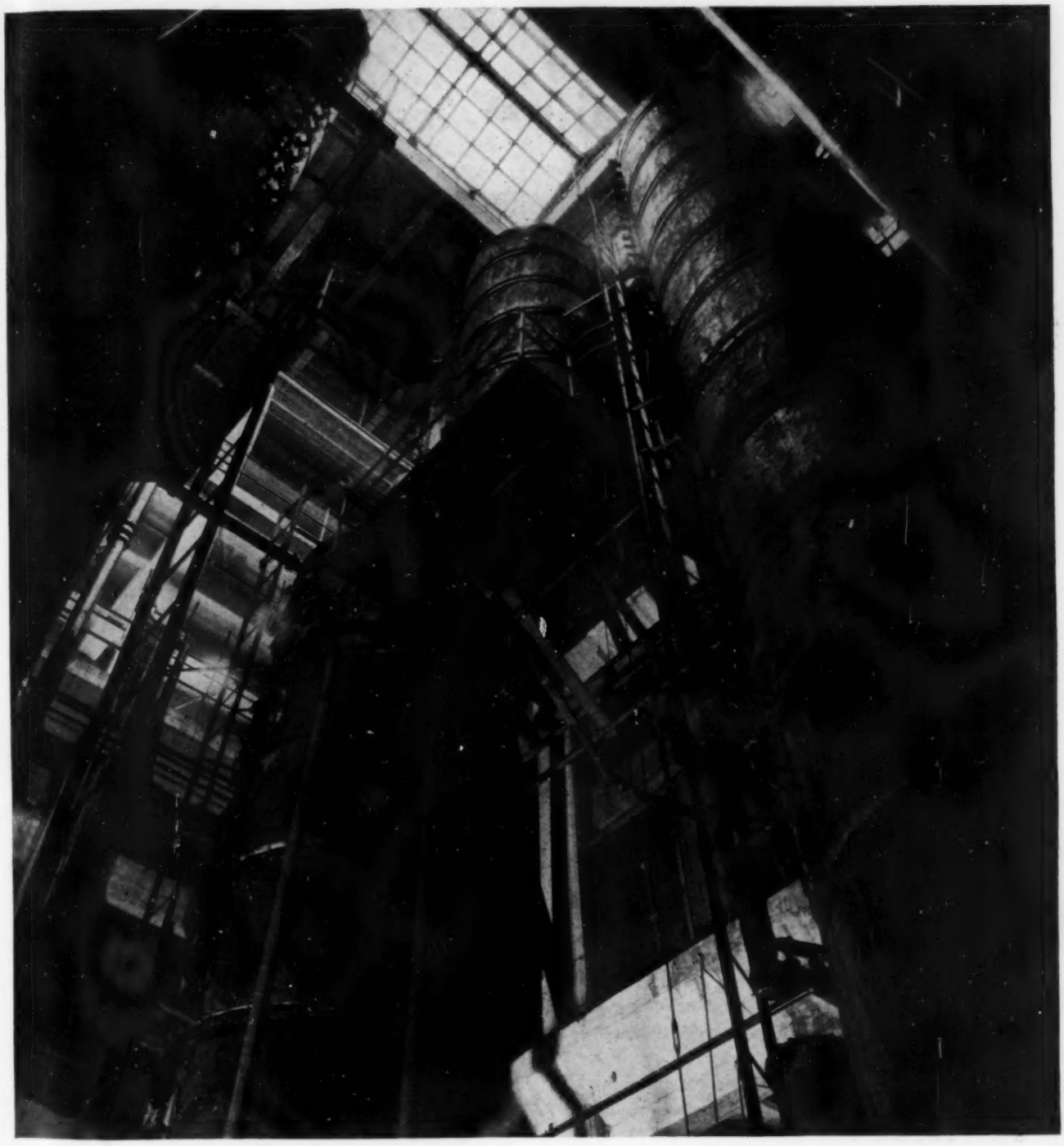

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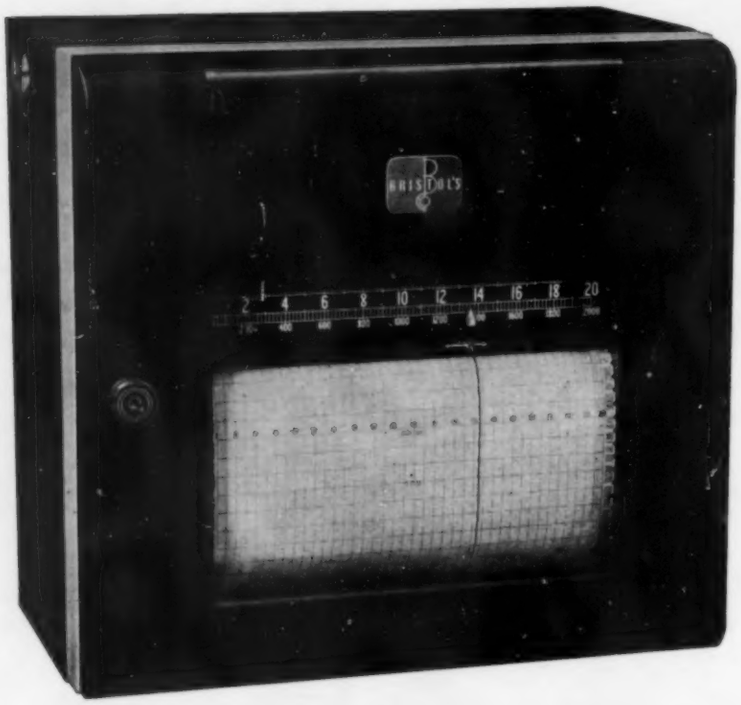
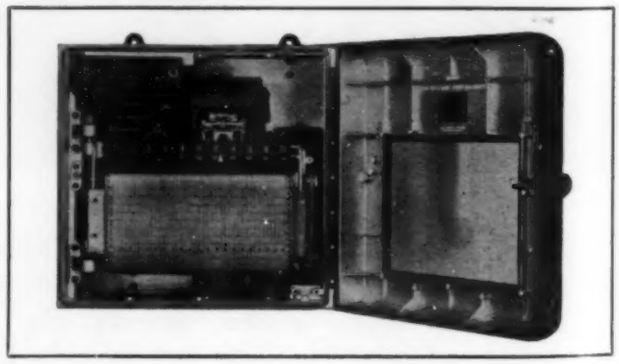


Built by the pioneer makers of Pyrometers, this latest Bristol's sets a new standard in potentiometer design and craftsmanship

Only a mere month or so has elapsed since this new Bristol's Wide-Strip Pyrometer was first announced at the Chicago National Metal Congress in October. Yet according to the ever-increasing number of enthusiastic reports that are coming in, it is the finest pyrometer ever presented to industry! Again Bristol design and craftsmanship have triumphed!

The use of a new principle in the balancing mechanism permits even the smallest deflections of the galvanometer to be measured and recorded. The pen responds promptly. Balance is quickly restored. Changing temperatures are speedily and accurately charted. Thanks to the elimination of back lash, lost motion, irregularities and the uncertainties unavoidable with friction wheels, ratchets and the like, this Bristol's sets a new standard in simplicity.

There are many features which merit careful appreciation. Besides the unusually wide strip chart, "far vision" indicating scale, heavy duty galvanometer, duplex slide wire, these are fully described in Catalog 1450 mailed on request. Write for a copy.



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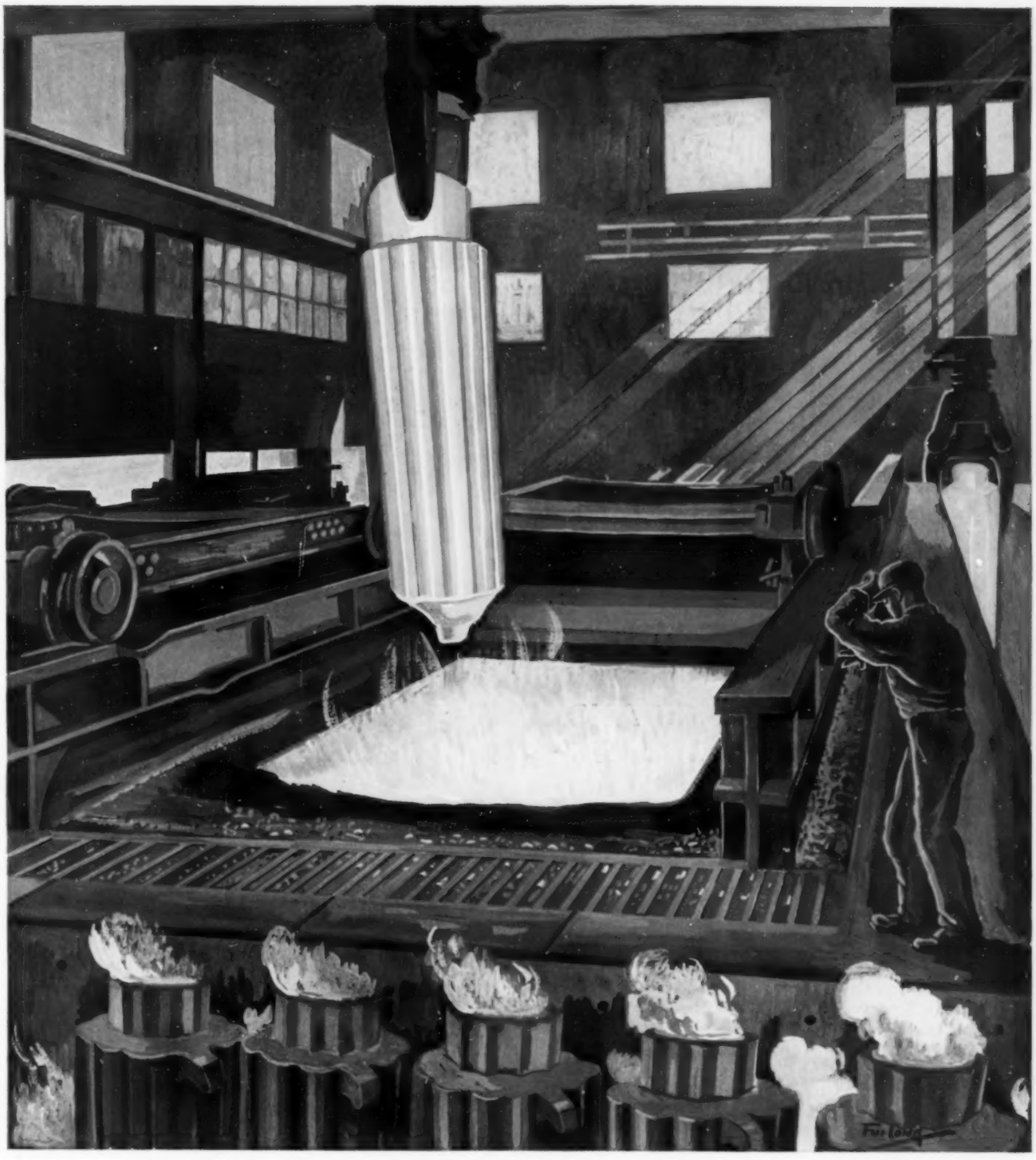
TRADE MARK REG. U.S. PAT. OFF.

WIDE-STRIP POTENTIOMETER PYROMETER

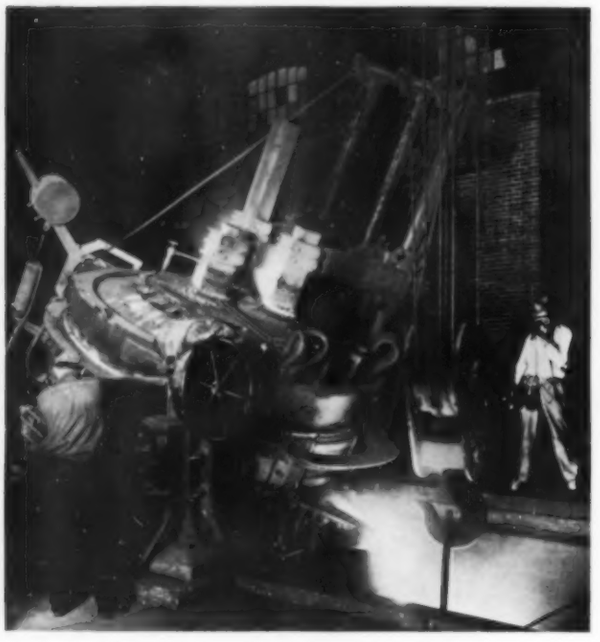


THE soaking pit receives the hot ingot and brings it throughout to the precise temperature that is most suitable for the intended rolling or other working. Reheating in the soaking pits is but one of the many steps in steelmaking where the "know-how" assures the intrinsic quality and uniformity of the finished product.

BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA.

BETHLEHEM PRODUCTS
for the Chemical Industries



STUDS, BOLTS AND PRESSURE SCREWS

BETHLEHEM Studs, Bolts and Pressure Screws are made from Bethlehem Alloy Steels that have been developed especially to withstand conditions too severe for fastenings of ordinary steel. Whatever the application — resisting high temperatures, shock, fatigue, or corrosion, there's a Bethlehem Alloy Steel that will meet it. These steels include:

SUPERTEMP, a chromium-tungsten steel for severe service at temperatures up to 1050 deg. F.

SAE 4140, a chromium-molybdenum steel for heavy duty at temperatures up to 900 deg. F.

MAYARI "A", a chromium-nickel steel for heavy duty at temperatures up to 850 deg. F.

BETHALON AND BETHADUR, low-carbon chromium-nickel steels with high corrosion-resisting properties.

Studs, bolts and pressure screws made from these steels may be depended upon for long, trouble-free service in any chemical-plant application. Each steel is available in bar stock as well as in the finished product.

FLANGED PRODUCTS

BETHLEHEM'S Flange Shop, located near the plate mills and open-hearth furnaces, is equipped to give exceptionally prompt service on flanged or flanged-and-dished heads. Ellipsoidal, conical, dished or hemispherical shapes. Standard or shallow types. Also, flue holes; manholes and handholes; saddles and covers.

BETHLEHEM-DAHL OIL-BURNING SYSTEM

THE Bethlehem-Dahl Oil Burning System is of the mechanical-atomizing type, using the pressure of the oil as it is brought to the burners. This method is efficient, quiet and economical to operate. Positive air control enables the operator to admit the exact amount of air required for perfect combustion. The Bethlehem-Dahl System can be applied to practically any type of boiler of 100 hp. or over, and burns successfully any grade of fuel oil, even the heaviest.

SEAMLESS PRESSURE VESSELS

THE strength of Bethlehem Forged Seamless Pressure Vessels is the strength of a single piece of homogeneous, thoroughly-worked steel, completely free from seams or joints. High-pressure processes can be carried on safely in these dependable vessels.

Bethlehem has the facilities and the experience to make forged seamless vessels in a wide range of lengths, diameters and wall thicknesses.

STEEL PLATES

UNUSUAL plate applications in the chemical industries present the steel-maker with some of his most difficult problems. The manufacture of plates to resist high pressures, extremes of temperature, corrosion or abrasion, calls for much greater skill and experience than are required in making plates for ordinary tasks.

Aided by wide experience, skilled personnel and unusual facilities, Bethlehem is solving such problems every day. Some of Bethlehem's largest plate customers are makers of equipment for the chemical industries.

BETHLEHEM ABRASIVE-RESISTING PLATES put an end to the rapid wear ordinarily encountered in bins, chutes, pulverizers, blades, hammers and other equipment handling abrasive dry chemicals.

These steel plates cost only slightly more than plates of ordinary steel but have from three to ten times their resistance to abrasion. They have sufficient ductility to permit bending, machining, drilling or welding.

BOILER TUBES

GENUINE old-fashioned knobbled charcoal iron tubes; double-pass steel tubes. Double-pass copper-bearing steel tubes.

CASTINGS

IRON, carbon and alloy steel, manganese steel, brass and bronze, rough as cast, or machined. Nitrate and acid pots; 88-80 Castings, resisting abrasion and giving longer life to crusher rolls, ball-mill liners and similar parts.

Bethlehem District Offices are located at Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Indianapolis, Kansas City, Milwaukee, New York, Philadelphia, Pittsburgh, San Antonio, St. Louis, St. Paul, Washington, Wilkes-Barre, York. *Pacific Coast Distributor:* Pacific Coast Steel Corporation, San Francisco, Seattle, Los Angeles, Portland, Salt Lake City, Honolulu. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA.

Getting a Leap on Leap-Year!

He's making a call *NOW* that will mean 366 days of saving *NEXT YEAR*

He's made a discovery. While studying his cost sheet carefully, he's found that lubrication costs can be traced in a lot of columns besides the one headed "Lubrication"; that they are written, in fact, clear across the cost sheet! He found a large item for repairs and labor, for instance, which he remembers was due to lubrication trouble. Right next to this, a much larger item, which was lost production while machines stood idle. He realizes that wear on machinery and maintenance costs must also be considered in total lubrication costs. That call he is making *now* is going to bring him savings that will spread through the whole next year. He is calling his local Standard Oil office.

Just a phone call to *your* local Standard Oil office will bring you the Lubrication Engineer and the assurance that nothing more can be done to lower lubrication costs in your plant. Correct Lubrication is his specialty, and Correct Lubrication *reduces* costs and accumulates savings *day by day!* His service implies no obligation whatever. So get a leap on Leap-Year *now!*

Copr. 1935, Standard Oil Co.

STANDARD OIL COMPANY (INDIANA)

CORRECT LUBRICATION

. . . and it can happen to you

An Illinois manufacturer was having trouble with a worm gear drive on a heat treating oven. Due to the high temperature, a bronze gear would last only three months. Calumet Cylinder Oil was recommended by a Standard Oil Engineer. The gear is still in use after five years and the saving amounted to over $300.00 per year.

By putting in a closed oiling system and equipping the stacks with single capillary feed oil cups, a saving of *$14.00 per day* was effected by a Standard Oil Engineer on the lubrication of calender stacks for a water power and paper company in Wisconsin.

The Lubrication Engineer often cuts costs just through practical suggestions on equipment and methods. His interest in your problems is sincere.

Note the list below. Check the papers you desire. Address your request to: STANDARD OIL CO. (Indiana), 910 South Michigan Ave., Chicago, Ill.

POWER

- ☐ "How to Cut Coal Handling Costs"
- ☐ "Steam Engine Lubrication"
- ☐ "Diesel Engine Bearing Lubrication"
- ☐ "Diesel Cylinder Lubrication"

PAPER INDUSTRY

- ☐ "Paper Machine Lubrication"
- ☐ "Lubrication of Beaters and Jordans"
- ☐ "Wax in the Paper Industry"
- ☐ "Lubrication of Power Transmission Equipment"
- ☐ "The Lubrication Engineer—His Value to You"

(227)

Name .....

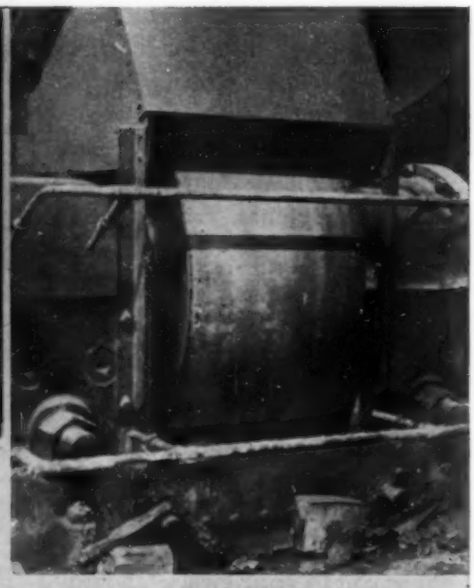
Position .....

Company .....

Address .....

City ..... *State* .....

Cement Plant saves over $5,000



Left — Trunnion bearing block after bronze-welding had been partially completed.

Right — General view of trunnion bearing blocks which support the huge cement kiln.

OXWELDING

KEEPS KILN BLOCKS OFF SCRAP PILE

FREEZING of the cooling water in eleven 1500 lb. cast iron trunnion bearing blocks of a 290-ft. cement kiln fractured all the blocks. Replacement would have cost the plant over $5,000.00. Repair seemed hopeless. Oxwelding, however, was employed to restore these blocks. About 8 hours of welding completed each block at a cost of about $35.00 each. New ones would have cost $500.00 apiece.

Thus does oxwelding frequently save the cost of new parts—and, what is more important, it often prevents expensive delays and the added penalties which shutdowns always impose.

As a companion tool, oxy-acetylene cutting also saves hours and dollars in the fabrication of many replacement parts. The oxy-acetylene process indeed is the stand-by for quick and low cost repairs to all kinds of equipment.

To secure the manifold advantages and economies of oxy-acetylene welding and cutting, consult freely with Linde's service engineers. Their broad experience is available through Linde Sales Offices located in principal cities throughout the country and at 30 E. 42nd St., New York, N. Y. Address—The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation.

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES

FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE UNION CARBIDE

$20,000 LOUISVILLE DRYER REPLACES $40,000 SYSTEM— AND SAVES $14,850 ANNUALLY!

ALL dryers look somewhat alike. But that's where the resemblance usually ends.

In the actual case featured here, the difference between a duplicate of the former dryer and the present Louisville installation was sufficient to save the customer $20,000 (50%) on purchase price, and to return an *operating* saving of nearly $15,000 *every year.*

FORMER DRYER	
Installed Cost	$40,000
Annual Production (Tons)	6,000
Drying Cost Per Ton	$3.72
(Space Required, 1500 sq. ft.)	
LOUISVILLE DRYER	
Installed Cost	$20,000
Annual Production (Tons)	9,000
Drying Cost Per Ton	$0.83
(Space Required, 500 sq. ft.)	
Yearly Savings of Louisville Dryer, in Operating Costs Alone	$14,850

Louisville Dryers are not always cheaper than "competitive" systems—in fact, they rarely are. But unless we can show a *more* than compensating economy in operating costs, we will not even recommend our equipment. . . .

Shall we figure the possibilities for you? *Address:* Louisville Drying Machinery Co., *Incorporated,* 451 Baxter Avenue, Louisville, Ky.

. . . The world's oldest and largest exclusive manufacturers of rotary drying equipment—specialists in the development of drying systems for the process industries.

You can't

Increased production schedules for 1936 will put the brunt on your Power Plant. Can it take it?

With the expected increase in orders for 1936, this is an appropriate time to give new consideration to both production and power plant equipment.

Higher operating speeds, in many cases worn out machines, and the need for keeping every unit on the job—all suggest a re-checking of the efficiency of their lubrication.

For your turbines, Texaco Regal Oils will secure continuous top-performance under heavy loads. Used by turbine operators in all parts of the world, these high-quality oils have shown top-notch performance records.

For your manufacturing plant, there are Texaco Lubricants made especially for getting the most out of each and every unit, old or new, regardless of its particular requirements.

With exactly the right lubricant in each bearing, you will be prepared for whatever demand is made upon you in 1936. Call in the Texaco representative. His friendly, cooperative counsel may save you money.

THE TEXAS COMPANY
135 East 42nd St. · New York City
Nation-wide distribution facilities assure prompt delivery

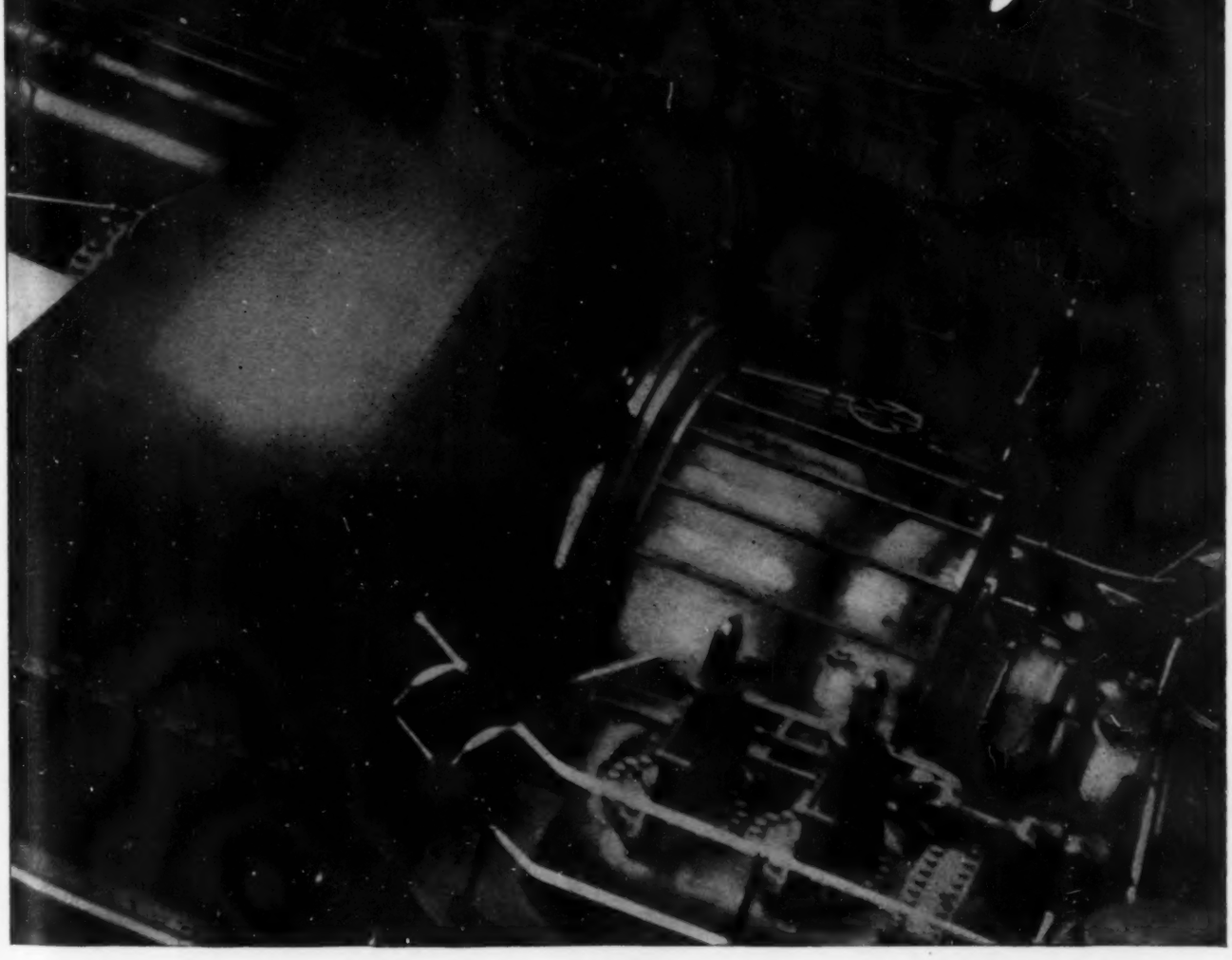
TEXACO tested

REFINERY TESTED FOR UNIFORMITY . .

deliver the goods

unless

Power Plant delivers the *"Juice"*

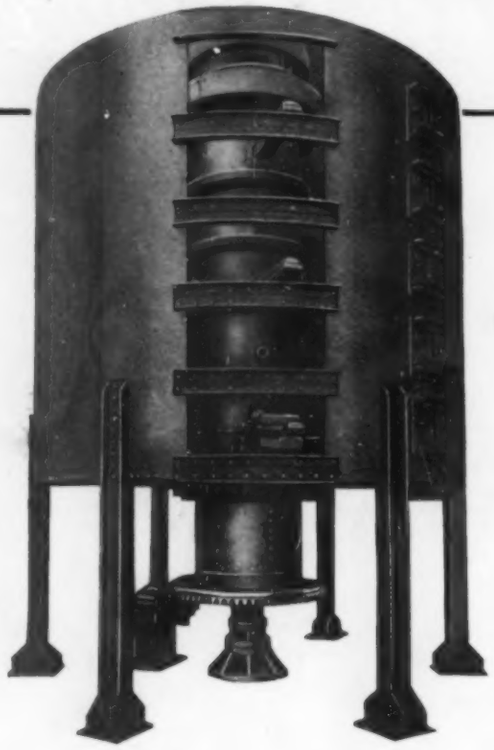


LUBRICANTS

. . SERVICE TESTED FOR ECONOMY

RECOVERED

TWENTY TONS OF PROFITABLE BY-PRODUCT PER DAY . . . . .



This Bethlehem Roaster (photographed in the course of erection) amortized itself in ten months.

and the investment was amortized in 10 months

35 tons of waste per day—converted into 20 tons of profitable by-product.

This is not an isolated case but rather is a typical instance of the application of Bethlehem Roaster processes for waste recovery.

And here is the way such problems are approached.

Bethlehem Foundry engineers study a sample of the waste material and offer an opinion on its possibilities. If this analysis justifies further investigation, they suggest an inexpensive experimental unit to prove, in advance, that the material's recovery will be commercially profitable . . . Based on the performance of this unit—an accurate estimate may then be made as to the length of time which will be required to amortize the necessary investment in production equipment—and the resultant profit to the user.

What waste recovery possibilities exist in your plant? Do you know? Let Bethlehem Foundry engineers help you find out.

BETHLEHEM

FOUNDRY & MACHINE COMPANY

BETHLEHEM, PENNA., U.S.A.

Sinbad's Burden

... Yielding to the pleadings of the Old Man of the Sea, Sinbad lifted him onto his shoulders and carried him tenderly across the stream. To his amazement, the Old Man refused to alight. Instead, he entwined his legs so tightly around Sinbad's chest that he could not be shaken off. Day after day Sinbad's burden became more and more crushing. . . .

A MATERIAL, process or modus operandi will sometimes so firmly imbed itself in the construction of an implement, appliance, engine, machine, vehicle, or part, that discarding it in favor of something more modern is often difficult. Meantime, its continued use may become a serious burden to both production and sales departments. . . . For competition is ever ready to capitalize a rival's lack of progressiveness.

Is the persistent retention of once modern steels threatening to leave your company behind in the face of the newer discoveries of metallurgists and steel-makers? Have you brought yourself up to date on the latest progress of Molybdenum — the alloy which not only improves ordinary carbon steel, but actually increases the effectiveness of other alloys?

Greater strength, toughness and shock resistance, less temper embrittlement, easier machinability and welding — these are some of the qualities "Moly" imparts to steel and iron. Yet so powerful is Moly, and so little is the quantity required, that it seldom adds to — and generally reduces — the ultimate cost . . . because it usually lowers the first cost in alloy content, means fewer rejects and effects other shop economies.

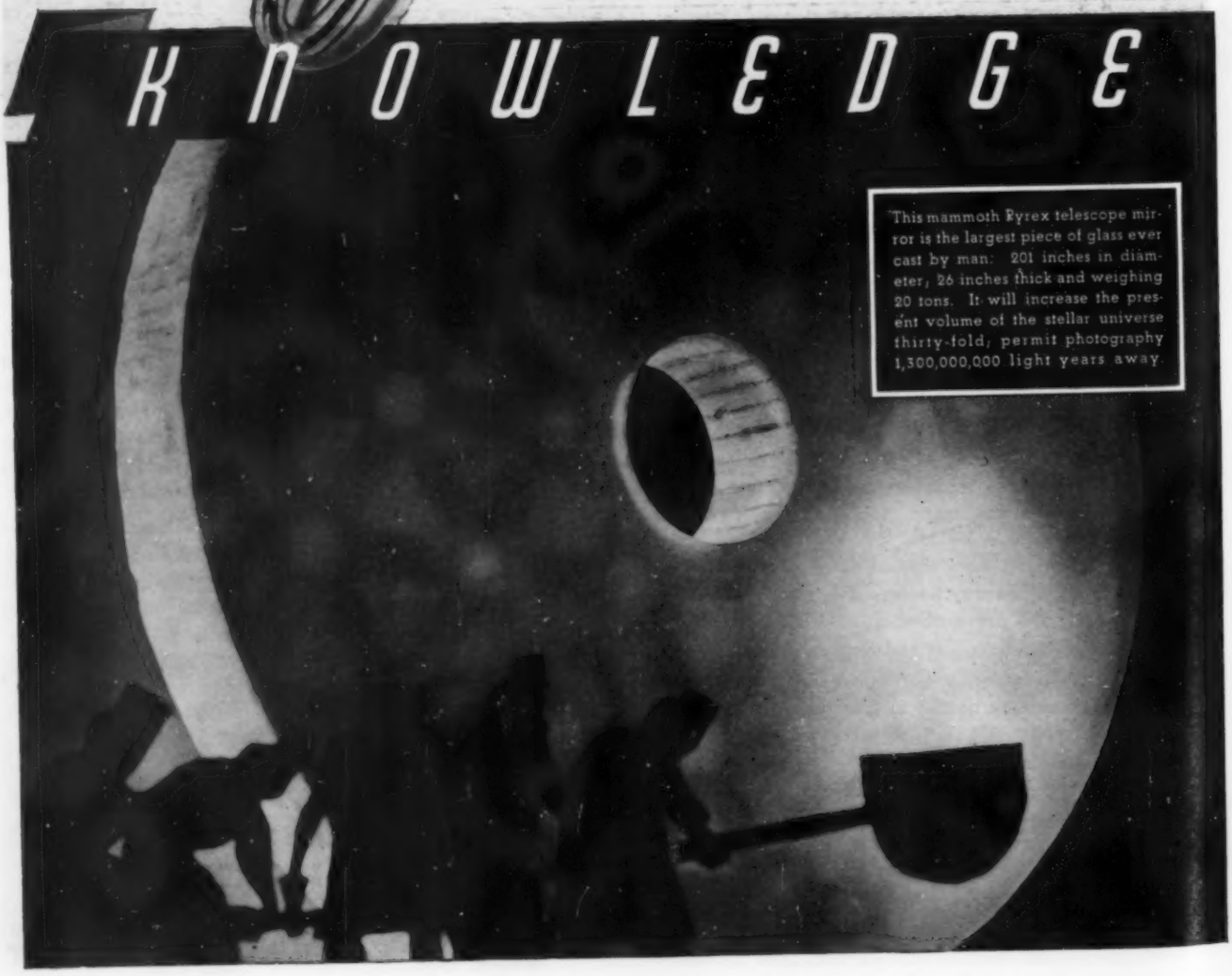
Investigate Moly. Moly has had more than a decade of countless laboratory, steel-furnace, foundry, forge and punishing service tests. We invite engineers, metallurgists, production and business executives to write for either or both of these interesting books: "Molybdenum in 1934" and "Molybdenum in Cast Iron — 1934 Supplement." Also ask us to mail you our periodical news-sheet, "The Moly Matrix." Be free, too, to enlist the aid of our Detroit experimental laboratory. Climax Molybdenum Company, 500 Fifth Avenue, New York.

MOLY

CLIMAX **Mo-lyb-den-um**

INDUSTRY'S MOST MODERN AND VERSATILE ALLOY

Pyrex GLASSWARE PIERCES THE BARRIERS TO KNOWLEDGE

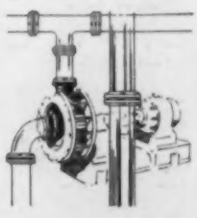


This mammoth Pyrex telescope mirror is the largest piece of glass ever cast by man: 201 inches in diameter, 26 inches thick and weighing 20 tons. It will increase the present volume of the stellar universe thirty-fold; permit photography 1,300,000,000 light years away.

The PYREX trade-mark identifies ware manufactured by the Corning Glass Works which includes piping, tubing, insulators, ovenware, industrial, laboratory, signal and architectural glassware.

AND PROGRESS

Whether it be the Scientist searching millions of miles into space or the Technician searching for a better material, they both rely on PYREX Brand Glass. ★ The same meticulous study and research which made possible the giant mirror for the Mount Palomar telescope, is also a deciding factor in the perfection of Pyrex Piping and Tubing, Pyrex Insulators, Pyrex Laboratory Ware and dozens of other products molded of this unusual and versatile glass. This research, while it gave the world the Pyrex glasses, is today constantly striving to improve their known quality. ★ Already such characteristics of Pyrex Glassware as visibility, mechanical and thermal strength, resistance to corrosion, erosion and contamination, and near-diamond hardness are playing a part in the advancement of science and industry. Corning engineers are equipped, and eager, to make these features contribute to the betterment of YOUR product or process.



Pyrex

T.M. REG. PYREX U.S. PAT. OFF.

"PYREX" IS A TRADE-MARK AND INDICATES MANUFACTURE BY

CORNING GLASS WORKS, CORNING, N.Y.

smoke..fumes..vapors...

The WESTON INDICATING ALARM

PROVIDES AUTOMATIC ECONOMICAL CONTROL!

Smoke is costly . . . both in fuel consumed and in anti-smoke ordinance fines. Now . . . these losses can be prevented, with an automatic and inexpensive Weston Indicating Smoke Alarm. Conveniently located in the boiler room, this device keeps the engineer constantly informed of smoke conditions in the stack. But before smoke can become excessive an alarm is sounded, which permits corrections to be made before losses are incurred.

The Weston Model 708 Alarm also is ideal for indicating the presence or concentration of fumes and vapors in processing plants, and to give warning of excess amounts. This can be done directly in some cases; and in others, by means of intermediate chemical reactions.

Complete data on Model 708 is available. Write for literature . . . Weston Electrical Instrument Corporation, 590 Frelinghuysen Avenue, Newark, New Jersey.

WESTON *Instruments*

The ABC's of food-handling and processing equipment..

ALLEGHENY METAL is BETTER, and CHEAPER in the end

Equipment made of ALLEGHENY Metal always looks well; lends itself perfectly to sanitary efforts; resists wear, chipping, denting and all ordinary forms of corrosion; protects the product from any suggestion of metallic taint; cleans easily and quickly; reduces operating, maintenance and depreciation costs. You'll find it a wise and economical move to specify "ALLEGHENY Metal" on your next equipment purchase.

ALLEGHENY STEEL CO... Brackenridge, Pa.

Sales Offices and Warehouse Stocks in the Principal Cities
Warehouse stocks are carried by JOS. T. RYERSON & SON, INC., WAREHOUSES
Union Hardware & Metal Co., Los Angeles . . . American Brass & Copper Co., San Francisco—Oakland
ALLEGHENY PRODUCTS: SHEETS FOR AUTOMOBILE BODIES, METALLIC FURNITURE, DEEP DRAWING, ALLEGHENY METAL, ALLEGHENY STAINLESS STEELS, ELECTRICAL SHEETS, STEEL CASTINGS, SEAMLESS TUBING, BOILER TUBES, PIPE
(Allegheny Metal is licensed under Chemical Foundation patents Nos. 1,316,817 & 1,339,378)

Allegheny METAL

ALLEGHENY METAL

The time-tested stainless steel

Goodrich Tank races for

• **ABOVE:** *Goodrich Tank for dissolving scrap iron. A similar Goodrich Tank has operated outdoors, in the yard of this company, for 4 years without a leak.*

• **ABOVE:** *View of above tank just after completion. Brick sheathing protects lining from gouging by the scrap.*

• **AT LEFT:** *Triflex lining being applied by Vulcalock process to sixty-foot steel tank in the Goodrich factory. Note Triflex expansion joints.*

Goodrich

thermometer—0° to 200°
4 YEARS WITHOUT A LEAK

• Four years ago a large chemical manufacturer installed a Goodrich Rubber-lined Tank for dissolving scrap iron in hydrochloric acid. Outdoors as it is, temperature of the rubber lining changes quickly, many winter days, from sub-zero to more than 200° F. Every day, winter or summer, the temperature change is drastic. Every day the tank has to stand the terrific impact and gouging of tons of scrap iron.

For four years the tank has been standing it—and not one leak has developed. Naturally, then, when this concern expanded recently, and needed another tank, they bought Goodrich. Every other tank they had used in this service had quickly developed leaks. But the Goodrich tank seems to be leak-proof and destruction-proof.

Leaks in any acid-handling operation are expensive, often dangerous. To see how leaks can be prevented look at Goodrich Triflex lining:—

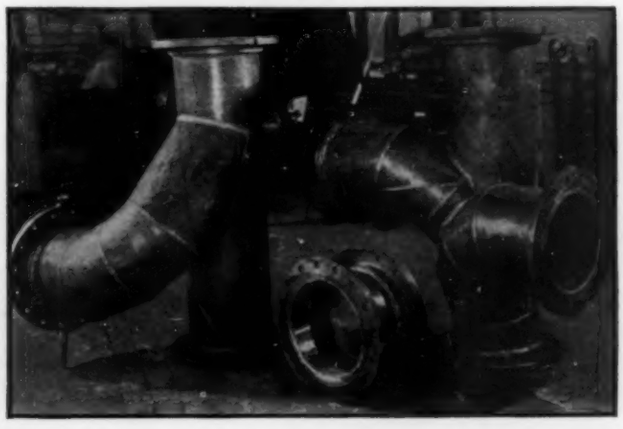
Triflex is really three linings in one. It consists of a layer of hard rubber for acid resistance between two layers of soft rubber for protection. The hard rubber is fitted with expansion joints so that it cannot buckle nor crack with the expansion and contraction of alternate heat and cold.

The outer layer of soft rubber protects the hard rubber, and for severe service further protection can be obtained by brick sheathing.

The inner layer of soft rubber grips the steel tank because it is applied by the exclusive Goodrich Vulcalock process which produces an inseparable bond. Since no dope or filler is needed to provide adhesion, a Goodrich lining can be made of the exact rubber compound best suited to whatever acid you use.

Triflex lining is 100 times as strong as a single rubber lining. It saves the money you now spend in tank repairs, lining repairs, shut-downs caused by leakage. Triflex makes acid-handling equipment *permanent.* Send for a free sample and prices, to The B. F. Goodrich Co., Mechanical Rubber Goods Division, Akron, O. (In Canada: Canadian Goodrich Co., Ltd., Kitchener, Ont.)

• *"Paid for itself in two years"—that's what this customer had to say regarding Goodrich rubber lined storage tank and distribution system used for handling hydrochloric acid.*

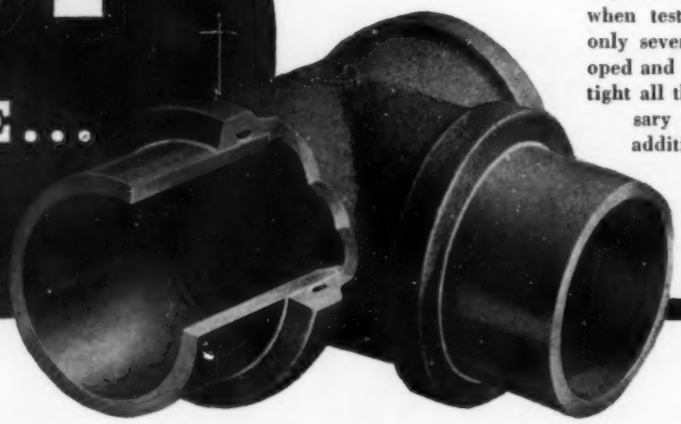


• *Even complicated fittings can be rubber lined by the patented Goodrich Vulcalock process which assures a rubber to metal adhesion of 500 to 700 lbs. per square inch.*

Rubber Lining

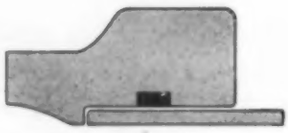
ALL *products problems* IN RUBBER

IT IS EASY TO MAKE...

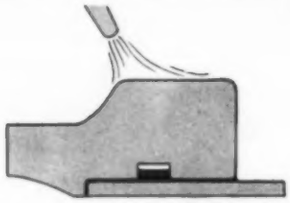


On an installation of Walseal valves and fittings just completed, in which there were over 10,500 Walseal joints, when test was applied only seven leaks developed and to make these tight all that was necessary was to apply additional heat.

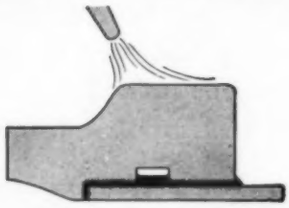
...A PERFECT WALSEAL JOINT



• A ring of Sil-Fos brazing alloy (melting point 1300° F.) of the proper quantity is incorporated in each Walseal Bronze Fitting and Valve.



• The heat of an oxy-acetylene torch applied according to instructions causes the Sil-Fos to flow, completely filling the space between the Walseal fitting and the pipe.



• Sil-Fos impregnates both pipe and fitting making a "one-piece pipe line." The safest and fastest way of making a tight, non-ferrous joint.

First the end of the pipe is cleaned and slightly fluxed. Then the end is slipped into the fitting . . . an oxy-acetylene flame is applied, and when the silver Walseal ring appears you have visible evidence that a perfect joint has been made.

There is no chance of using the wrong brazing alloy with Walseal. Exactly the right amount of "Sil-Fos" brazing alloy is built into every fitting. There is no possibility of having excess alloy plugging the line. The finished Walseal joint — brass or copper — is stronger than the pipe itself. It is proof against vibration, corrosion and creep. It cannot pull apart under any temperature to which brass or copper pipe can safely be raised.

The Walseal Fittings, Flanges and Valves are made for iron-pipe-size brass pipe and extra heavy brass pipe. Walseals can also be used for I.P.S. O.D. thin wall copper tubing (no adapters necessary). They are available in sizes ¼-inch to 8-inch fittings; flanges 1½-inch to 12-inch.

WALWORTH

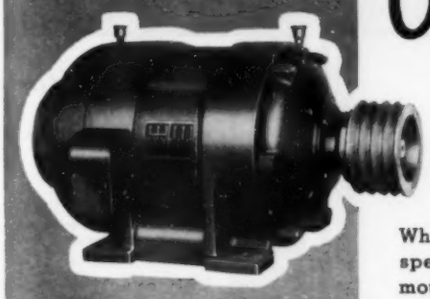
VALVES FITTINGS and TOOLS
Backed by 93 Years' Service

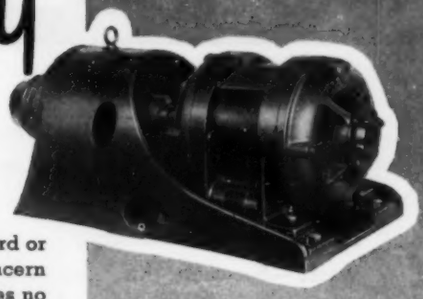
WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

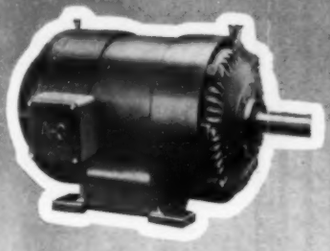
NAME YOUR MOTOR REQUIREMENTS

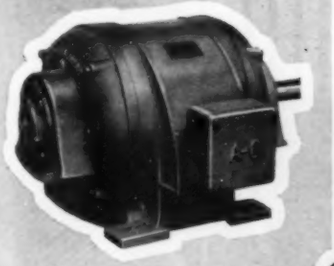
We supply them!

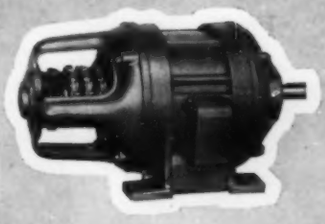


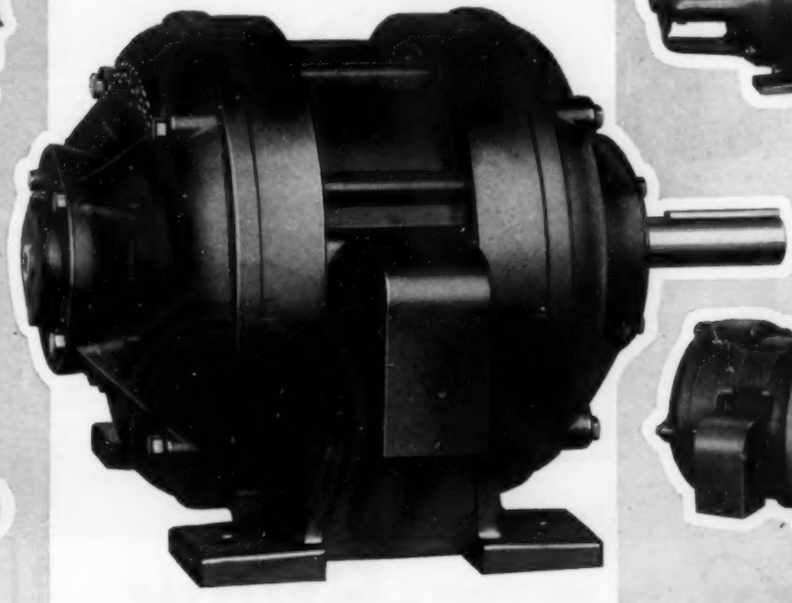


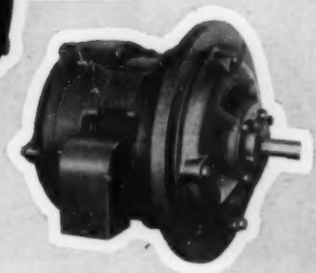
Whether your motor requirements are standard or special, or whether the desired features concern mountings or electrical characteristics makes no difference . . . we supply your motor needs and do so with performance plus. • A small plant in Norwood, Ohio, which became a part of the Allis-Chalmers Mfg. Co. forty years ago, pioneered in the building of standard and special motors. • Allis-Chalmers manufactures the most diversified line of machinery of any company on the American continent. • All the motor knowledge gleaned from pioneering days to the present time and all the experience acquired in producing motors for its own vast line of rugged power driven machinery are the inheritance of Allis-Chalmers Motors today . . . that knowledge, that experience and the guiding principle of quality as an ideal are built into every Allis-Chalmers Motor. They are the sturdiest motors on the market—bar none. Allis-Chalmers manufactures motors of every type, both standard and special, and their district offices, in all principal cities, are ready to assist you in all problems of motor application.











MOTORS

FOR EVERY PURPOSE

ALLIS-CHALMERS MFG. CO. MILWAUKEE, WISCONSIN

THE Demon Waste WOULD NOT APPROVE

THE Style A batch dryers pictured herewith promote efficiency in the drying of small quantities of tankage, wood flour, chlorides, chromates and similar materials. They are also used frequently in continuous operation to avoid contamination—and waste—between different lots or batches of the same material.

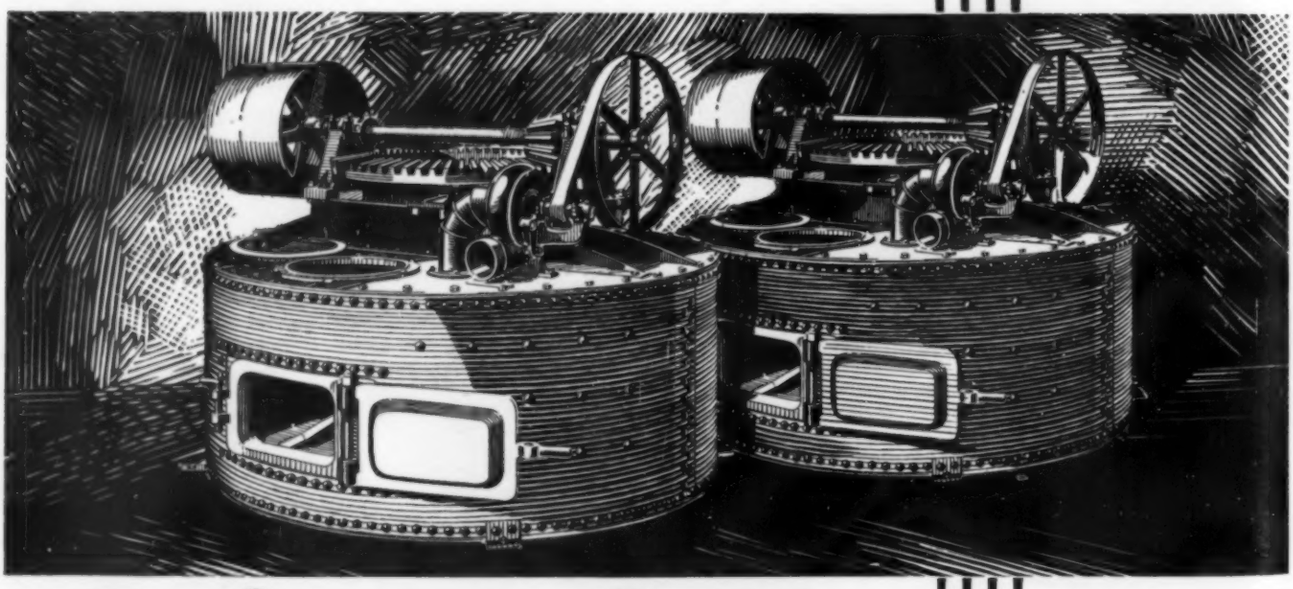
Filled from the top the material is kept in constant motion by an agitator that sweeps the charge against the jacketed sides and bottom and automatically empties the chamber when the material is dried.

Style A dryers are easily installed—they require no foundation. Those capable of handling a charge of 25 cubic feet, approximately 1200 pounds in a single batch, have found wide popularity throughout the entire chemical industries. They are carried in stock. Two other sizes are standard for larger capacities. Full details on request.

THE C. O. BARTLETT & SNOW COMPANY
6204 Harvard Avenue, Cleveland, Ohio
In New York, 30 Church St. *In Chicago,* First National Bank Bldg.

DRYERS *for*

Acetates	Cellulose
Acids	Oxalic Crystals
Carbonates	Calcium, Magnesium, Sodium, Zinc
Chlorides	Ammonium, Sodium
Fluorides	Sodium
Nitrates	Ammonium, Sodium
Nitrites	Sodium
Oxides	Iron, Silicon, Titanium, Zinc
Sulphates	Ammonium, Ferrous, Magnesium, Sodium
Sulphides	Iron
Ores	Fluorspar, Hematite, Ilmenite, Magnetite, Pyrites
Clays	Fire Clay, Fuller's Earth, Marl
Minerals	Asbestos, Mica
Organics	Lignin, Starch, Tobacco, Wood Flour



BARTLETT-SNOW *Rotary Dryers*

The installation of Bartlett-Snow bins, feeders, conveyors, elevators, crushers, screens, mixers and other accessory equipment fabricated from mild steel or special metals, enables you to insure the successful operation of the entire assembly as a unit. A complete service . . . with one responsibility.

SEE PAGES 160-161

Kilns
Calciners
Roasters
Coolers

In just a few short years . . . . . .

A small enclosed kettle over a masonry furnace. A pipe to condense the gasoline vapors. A spring to supply the cooling water. And from this simple oil refining equipment has sprung, in just a few short years, one of the world's largest industries. • The progress of the refining industry has paralleled the development of steels—steels to combat corrosion, steels to stand up under tremendous pressures, steels to withstand high temperatures. And among those steels capable of meeting the severe conditions of modern refinery service, none stands higher than ENDURO, Republic's Perfected Stainless and Heat-Resisting Steel. • ENDURO is available in a wide range of alloy combinations, permitting a selection of the grade most economical for the service in which it is to be used. These types cover an operating temperature range from 1100° to above 2100°. All are far superior to and more economical than ordinary steel for still tubes, condenser tubes, heat transfer units, hot oil and vapor lines, bubble caps, trays, plates, tube supports, hangers and valve and pump parts. • Republic metallurgists will gladly make recommendations if you will outline your requirements.

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ALLOY STEEL DIVISION · · · MASSILLON, OHIO

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REPUBLIC'S PERFECTED STAINLESS AND HEAT-RESISTING STEELS

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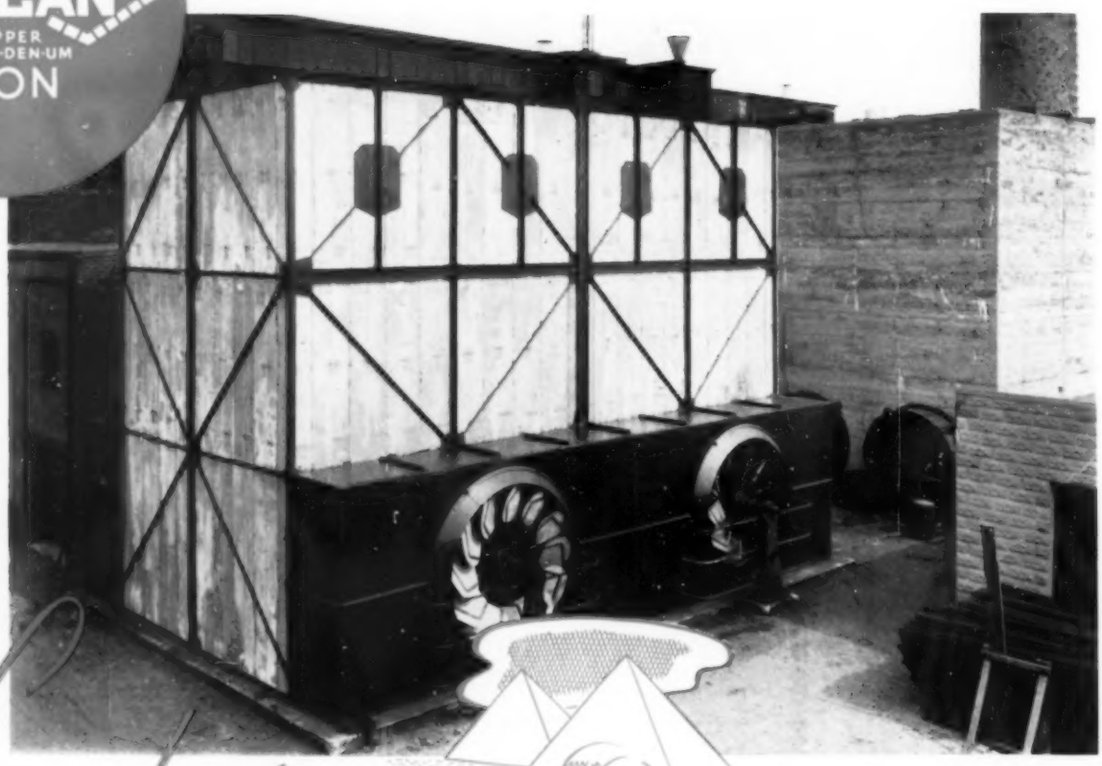

Long-lasting

UNDER ADVERSE CONDITIONS

Sheet metal is a mighty handy material to have around. It safeguards life. It protects valuable equipment. It confines heat and cold and directs them to the point where they are needed. It serves a thousand uses, because it is so adaptable.

But don't neglect, when you are using it, to think about these things. You have paid good money for the metal itself. You are spending more money to fabricate it. You are using it to do a definite job, and you want it to last even under adverse conditions where weather, steam, moist air, chemical fumes or a combination of destroying forces will pick it to pieces.

Where such conditions exist, the logical answer is Toncan Iron—the alloy of refined open hearth iron, copper and molybdenum with the highest corrosion-resistance of any ferrous material in its price class—the sheet metal that is being used today in homes, factories and public buildings wherever long service and low yearly cost are given the consideration they deserve.

"The Path to Permanence" is a book that will interest you. Write for a copy.

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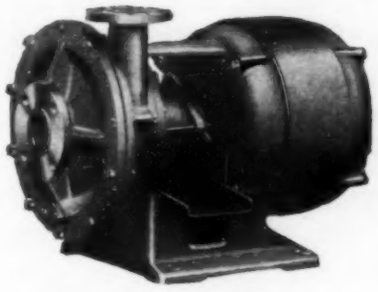
GENERAL OFFICES · · · YOUNGSTOWN, OHIO

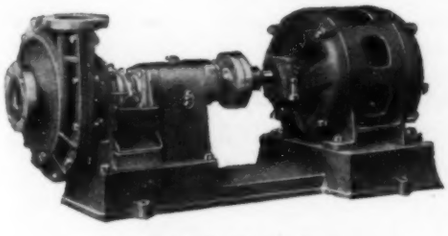
Du Pont Rayon—21 Olivites
Delaware Rayon—17 Olivites
Tubize Chatillon—17 Olivites
Hampton Company—16 Olivites
New Bedford Rayon—20 Olivites
Skenendoa Rayon—13 Olivites
Industrial Rayon—18 Olivites

The Rayon Industry *says to* The Process Industries

Use OLIVITE
Acid-Handling Pumps



Standard 1¼" Olivite Pump



Standard 2" Olivite Pump

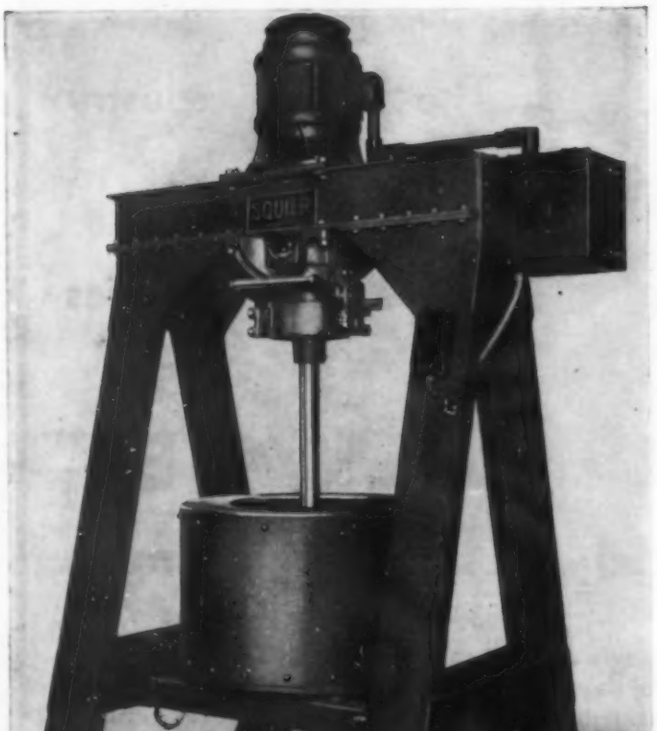
They sure are well sold on the Olivite Acid Pump in the Rayon mills! They like the floating stuffing box and the way the pump handles the hot and cold acids and other corrosive chemicals without leaking or squirting all over the place. They like the way efficiencies are maintained. They like the way the impeller is locked on the shaft and cannot back off. They like the durability of the special compound OLIVITE and its firm bonding to the metal casing and impeller. They like the way they can handle different corrosive solutions successively without contamination.

In short, the Rayon Industry likes the Olivite Acid Pump so well that it depends upon this pump for its acid-handling problems. It would pay other process industries to investigate the merits of this pump.

OLIVER UNITED FILTERS INC.

33 West 42nd St., New York, N. Y.
221 N. La Salle St., Chicago, Illinois
351 California St., San Francisco, Calif.

Super-strength *from* "safe" design—



IF YOU built a piece of machinery to be used from 3000 to 9000 miles from your factory, by a user with practically no facilities for making even minor repairs you'd be pretty sure that that machine would operate satisfactorily, wouldn't you?

Well, that's the reason that SQUIER chemical centrifugals are so popular in plants where they're installed. Because we've built centrifugals for distant sugar mills for more than thirty years—we long ago learned to design them so that they would stand the most severe service. With the comparatively recent improvements made possible by welding, and the use of various new metals, the SQUIER line of centrifugals is today an unusually satisfactory line. Why not let us quote on your next order—and get our specifications.

Ask
for this bulletin . . .

In addition to centrifugals, SQUIER manufactures dryers, coolers, evaporators, condensers, crystallizers, recovery stills and much special apparatus. Bulletin No. 2933 illustrates much of this equipment. Write for your copy.

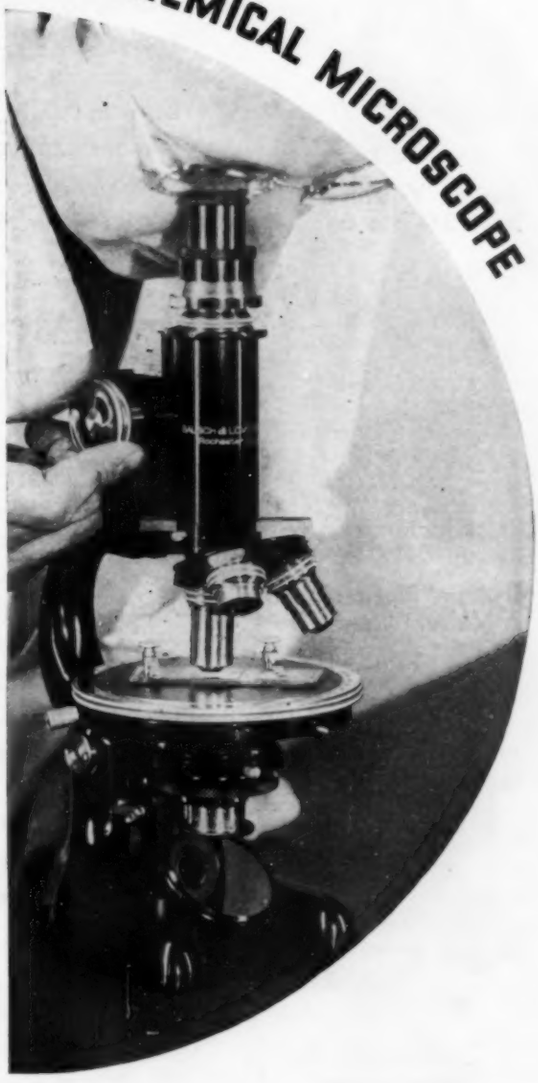
The Geo. L. Squier Mfg. Co.
501 Broadway, Buffalo, N. Y.
In Canada: Canadian Blower & Forge Company, Ltd., Kitchener, Ont.

"SQUIER" Centrifugals

DETERMINATION OF

*Melting points

IS BUT ONE OF THE MANY USES OF THE CHEMICAL MICROSCOPE



The B & L Chemical Microscope has become the right hand man of the progressive chemist. It is the instrument which he uses for rapid preliminary examination as well as when conventional methods prove inadequate. Why? Because this microscope is universal in scope. With the proper accessories it may be used for dark field work: metallography, bacteriology, particle size determinations, photomicrography and cotton fiber maturity determinations.

As a chemical microscope it is used to reveal optical characteristics, to determine refractive indices, to make quantitative analyses of mixtures, qualitative determinations and to determine melting points.

In the case of crystal or fiber identification where physical structure is important only the microscope can be used to get the necessary information. Write today for complete details. Bausch & Lomb Optical Co., 605 St. Paul St., Rochester, N. Y.

***Melting points of organic materials are more accurately determined with the M Microscope. This method is based on the fact that crystals lose their optical properties at their melting point. The observer therefore merely watches until a bright crystal is lost in the dark field created by crossed nichols, and checks temperature with thermometer, thermo couple or crystals of known melting point. The entire stage of the microscope is readily removable for use with a hot stage which the user builds to his individual requirements.**

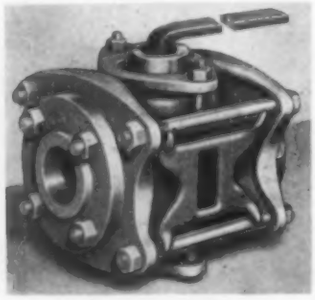
Bausch & Lomb

We make our own glass to insure standardized production. **For your glasses, insist on B & L Orthogon Lenses and B & L Frames.**

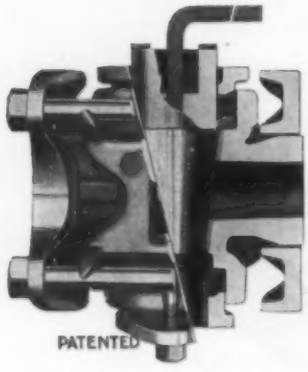
PHOTOMICROGRAPHY ❖ MICROSCOPY ❖ COLORIMETRY ❖ REFRACTOMETRY ❖ SPECTROGRAPHY

VALVES a vital part of your acid-handling system

Duriron Y Valve
Sizes 3/4" to 6"



Duriron "Plunger-Release" Valve. Sizes 1" to 4"



Cross-section, Duriron "Plunger-Release" Valve

WHEN VALVES FAIL on an acid line, everything stops until the repair is made. And "Stops" like that are expensive—processing is delayed, quality is threatened, loss is sustained, replacement costs money.

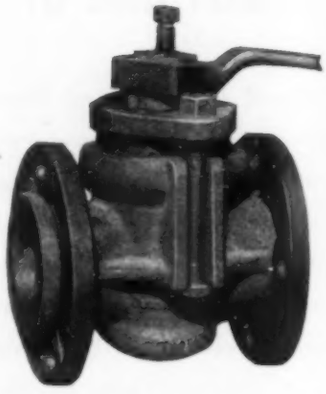
Duriron Valves have the intestinal fortitude to take the punishment of strong acids, weak acids, gritty abrasive solutions without giving up the ghost all of a sudden. They don't let you down.

To paraphrase an old saying: If you Chemical Engineers didn't like Duriron Valves, we wouldn't be selling so many of them.

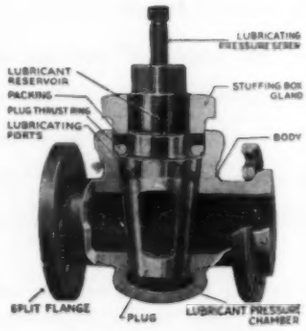
Try them on sulphuric acid in all concentrations and at all temperatures, oleum excepted; Nitric Acid, all strengths, Acetic Acid; Chromic Acid; Ferric Sulphate; Mixed Acid; Phosphoric Acid; Sodium Sulphide; Zinc Sulphate and other corrosive chemicals. And for Hydrochloric Acid in all concentrations and at all temperatures up to the boiling point, try "Durichlor" Valves.

If you are having your troubles with Corrosion, you might be able to lessen them with Duriron. Why not write? We will tell you just what we can do for you.

Bulletin No. 161 describes the different Duriron Valves and Cocks, giving sizes and dimensions. A copy is yours for the asking.



Duriron-Nordstrom Lubricated Valve. Sizes 1" to 6"



Cross-section, Duriron-Nordstrom Lubricated Valve

●

THE DURIRON COMPANY, INC.

424 N. Findlay St., Dayton, Ohio

Manufacturers of Chemical Equipment in

DURIRON—DURICHLOR—DURIMET—DURCO ALLOY STEELS—ALCUMITE

CHEMICAL & METALLURGICAL ENGINEERING

VOLUME 42 ESTABLISHED 1902 NUMBER 12

McGRAW-HILL PUBLISHING COMPANY, INC.

S. D. KIRKPATRICK, Editor

DECEMBER, 1935

THE PARADE MARCHES ON

SOBER CONTEMPLATION of the affairs of a busy, interesting month, climaxing an equally busy and interesting year, leads to one inevitable conclusion: Things have been moving forward at an increasingly rapid pace, particularly in the chemical engineering field. The Fifteenth National Exposition of the Chemical Industries was not only the biggest and best since 1931, but, for the first time in years, it reflected a definite advance in capital goods—the sector of the industrial front that has been lagging behind in previous rallies. The full significance of the almost universal display of new products and new processes may not be immediately apparent to the public at large, but to chemical engineers responsible for industrial advance, it can mean only one thing: The parade of progress is on its way.

Dr. H. C. Parmelee is one of those to see in this surge of new products and new industries "the main hope of an industrial nation for maintaining employment and advancing to a higher standard of living as a continuous process." In discussing these trends before the recent meeting in New York of the Associated Business Papers, he said, "Research is the price of getting into the industrial parade, or of staying in it if you are already in. Without it an industry can merely watch the parade go by and find itself bringing up the rear as a straggler, finally falling out altogether."

But in spite of the obvious necessity of continuing research, there are still some short-sighted individuals who would like to stop the parade—to declare a holiday so that the world can catch up with scientific invention. Or, in line with the current policy of restoring prosperity by creating a scarcity of raw materials and finished products, someone has proposed that "we plow under every seventh inventor." Dr. Parmelee's reply to such an obstructionist is worthy of repetition. He said: "But I know of no way of erecting stop-and-go signs to control the activities of the human mind. As long as men are curious about the unknown, as long as they wonder about things that are non-existent, as long as they have unsatisfied desires, just so surely are they going to engage in investigation and research that will result in scientific invention and product development."

Another of our colleagues, the editor of *Product Engineering*, lends statistical proof to the statement that the really smart companies have now concentrated their attention on new products and new designs. According to his recent survey, the employment of design engineers in 1935 has reached a five-year high that shows a 21 per cent gain over last year and is almost double the 1932 low. If that trend continues there is certain to be a shortage of engineering personnel—despite the heavy increase in college enrollments reported this fall from all over the country.

All of which sounds so much like 1929 as to warrant just a word of cautious wonderment. Many commodity prices are rising, speculators are becoming active, credit is freer than ever and will be still freer if we must have a soldiers' bonus with its big and inevitable bond issue. Some danger of inflation is still with us. It is time to look ahead—to make certain that the parade is marching in the direction of a safe prosperity—and not toward a perilous precipice.

From an EDITORIAL *Viewpoint*

Washington Uses Any Club at Hand

REGULATIONS by the Federal Government are now enforced by many novel means. Movement of petroleum as a commodity of importance in warfare is, for example, being limited by demanding that shipping companies who borrow from the Government conform with the wishes of the Administration, even in cases where there is no law permitting enforcement of the wish. Enforcing of the regulations under the Guffey coal law is being attempted by other strange means. No concern doing business with the Federal Government is to be permitted to use any coal except that which has been produced under the Bituminous Coal Code. A score of other examples could be cited in which federal authorities use devious and unusual means for enforcing the desires of regulatory agencies.

There is no doubt as to the desirability of some of the social legislation that is being formulated for the betterment of American conditions. But the intrinsic merit of the objectives sought does not justify indirection in the administration of the laws. There is perhaps no more dangerous evidence in Washington of a willingness to exercise the authority of a dictator than in such actions.

From Whence Our Future Motor Fuel?

IS PRODIGAL America wasting its substance in riotous driving? The American Petroleum Institute, as reported elsewhere in this issue, finds present known crude oil reserves in the United States ample to supply estimated domestic demands for about 13 years. Undiscovered reserves are depended on to extend this to at least 25 years. Will the motor car succeed in exhausting, in half a century, this national heritage of geologic ages?

The next source of gasoline, from coal, will certainly double the national motor fuel cost. The promised security from gasoline famine is temporary at best. Perhaps the best service which chemical engineer can render during the next few decades is the development of processes to increase the percentage of crude oil converted to motor fuel. In 20 years this percentage has been increased from 17 to 44 per cent. This still leaves a large percentage used for other purposes which will be sorely needed when coal gasoline enters the scene.

In ultimate development we shall have to consider a variety of raw materials for the motor fuel supply of the United States. In fact, already there are minor variations in type of gasoline which typify those more radical differences which are to come. For example, it is immaterial to the motorist whether he obtain straight-run gasoline, cracked gasoline, or some mixture of these, with or without ethyl fluid. What he wishes to buy is a combustible liquid suited to his motor car. And he is most pleased when he gets this at the minimum price.

In the future there will be no change in this situation. It will be immaterial to him whether he has plain gasoline, ethyl gasoline, poly gasoline, or the equivalent hydrocarbon from coal, oil shale, or other mineral source. He will be equally content, perhaps even better pleased, if he can get some mixture of these mineral fuels with alcohol, benzol, or other fuel, provided they are not too expensive. And the motor builder can be counted on to adapt his designs to prevailing types and purities of fuel commercially sold.

The job of the chemical engineer in all this is constantly to study methods of production with a view to relative cost under changing conditions of raw materials supply and known technical methods. The chemical engineer will not be negligent of his duty provided the funds needed for research and engineering development are regularly supplied.

There need be no jolt in transition as time goes on. Whatever the raw material and whatever the process, the product can and will be made for many generations to come in adequate quantity for as many motor cars as the public is able to buy and drive. The price will, to be sure, change; but even it will not move in jumps. Competitive conditions between raw materials and between companies will make certain for the customer that no excessive prices are charged.

Safety and Soy Beans

WITH the 1935 soy bean crop almost twice as large as that in 1934, in many rural communities plans are being laid for the erection of soy bean extraction plants. It is most unlikely that all of these operations will be carried out under the best of chemical engineering auspices. Therefore, it is important that the recent warning concerning hazards involved, issued by the Bureau of Chemistry and Soils, U. S. Department of Agriculture, be brought emphatically to the attention of prospective soy bean processors.

Not only does soy bean extraction require the use of hexane or other flammable solvents, but there is also a dust explosion hazard in the grinding and processing of the beans. Tests conducted by the Bureau have shown this danger to be no less than with grain dust.

One need recall only a few of the dust explosions of recent years to realize the potential loss of life and property which may follow a general adoption of such processing by inexperienced persons.

Undoubtedly the best insurance against serious consequences from a program of this sort lies in the employment of competent engineering advice in the design, construction and operation of the projected plants. But since the advice of professional consultants will not be sought in many cases, the bureau's cooperation should be enlisted by projects which otherwise would be inadequately engineered. Where a chemical engineer cannot ethically push his own services, he can at least, knowing of a proposed plant, direct the sponsors to the Bureau's Chemical Engineering Division. This course may react to his own advantage; in any event, he will be acting definitely in the public interest.

John Wesley Hyatt, Founder of Plastics

NOVEMBER 28 marked the ninety-eighth anniversary of the birth of John Wesley Hyatt to whom is given credit for the successful development of pyroxylin plastics. It is said that his attention was attracted to the possibilities of collodion as a plastic by the accidental spilling of a bottle of this solution in his shop. Whether that was the actual beginning of his interest in plastics or not he was able to make such remarkable strides that he was the first of several scientists working on the problem to perfect a commercial product. A patent was granted him in 1869. This date might well be accepted as the birth of the modern plastics industry. Fortunately he lived to see his modest development gain an important position in the industrial world.

Chain Store Chemicals?

WILD INDIANS no longer roam the western plains. Deserts, untouched forests and forty-niners do not greet the eye of the Easterner coming west for his first visit. Airplanes carry him to the Pacific Coast in a few hours, his freight reaches there in slightly more than a week by train and in about two weeks by boat. In short, the West is a part of the United States and not a foreign country nor a colonial possession.

These remarks, written from the Pacific Coast, are prompted by the belief that certain of our eastern chemical industries seem not to realize this relationship. We do not have in mind so much the practice of market sniping by some alkali manufacturers who sell a car of alkali "now and then" to a contract customer without bothering to learn whether it is to be used or resold. We do refer to the practice which has been started recently of selling to wholesale grocers and chain stores who can thus use reciprocal buying and selling position to force the sale of caustic soda out of legitimate chemical channels.

Most of us well remember the last disastrous alkali war. When it was over, who profited? Only the customer. Alkali manufacturers changed customers at cut-rate prices. There was little or no increase in the total alkali sold.

Must we now have another war of similar nature? Or can we overcome these unethical marketing methods without this needless loss? The West may be a factor sufficiently large in the next alkali war as to do permanent damage in the eastern market. Let us hope that those in command of chemical industry will not be so short-sighted as to aid the chain stores and wholesale grocers in getting into the chemical business. There is enough business for all at a profit, if that business is carried on legitimately. If it is not, there will still be business, but possibly not at a profit.

Can Petroleum Compete With the Vegetable Oils?

FOR SOAP MAKING, and for many other purposes, coconut oil is almost an essential. No other type of vegetable oil except this, and the closely related oils of other palms, contain the requisite percentage of capric, lauric, and myristic compounds. These acids of 10-, 12-, and 14-carbon chains are essentials for quick lathering, and satisfactory home performance of the soap. Hence it is not merely the preference of the soap maker that includes coconut-oil fatty acids in practically every formula.

Now come the organic chemists and suggest that they can make equivalent fatty acids by controlled oxidation of the corresponding hydrocarbons as found in petroleum. In fact they say that mixtures of hydrocarbons from C_8 to C_{12} or from C_{10} to C_{14} can as a group be so prepared as to be practically equivalent to the coconut-oil fatty acid as far as the soap-maker's requirements are concerned.

Experimentation in this field has not gone far enough to give general conviction. But there is no doubt as to the chemical possibility, almost the chemical probability, of such substitution. Many industries of the United States will be interested. Certainly it will be a tremendous chemical engineering achievement if one may take products of petroleum and the widely available corn and cottonseed oils and produce for the soap maker fatty acids just as satisfactory as those from the much less abundant coconut oil. An element of domestic security would thus be achieved. And possibly a tremendously enlarged outlet for corn and cottonseed oils might also be effected, to the benefit of our own agriculture.

Banquet Speakers: (Left to right), S. D. Kirkpatrick, toastmaster, A. E. Marshall, chairman of Committee of Award, Lammot duPont, president, and E. C. Robinson, general manager of Organic Chemicals Dept., E. I. duPont de Nemours & Co., Inc.

1935 Achievement Award to duPont

THE 1935 Award for Chemical Engineering Achievement was formally presented to the Organic Chemicals Department of E. I. duPont de Nemours & Co., at a dinner held at the University Club, in New York, Dec. 6, 1935, at the close of the Fifteenth National Exposition of Chemical Industries. The bronze plaque, emblematic of the award, was presented to Lammot duPont by A. E. Marshall, chairman of the committee of award. Mr. duPont thereupon turned it over to Edmund G. Robinson, general manager of his company's Organic Chemicals Department, stating "this honor should most certainly go to our Organic Chemicals Department since the achievements mentioned by your committee were entirely theirs."

S. D. Kirkpatrick, editor of *Chemical & Metallurgical Engineering* and toastmaster of the dinner, explained that the award had been made for "meritorious achievement in the successful large-scale production of the synthetic rubber, DuPrene, of synthetic camphor and a variety of other essential organic chemicals and dyestuffs." The presentation ceremonies were broadcast over Station WEAF and the Red Network of N.B.C.

In the address of presentation, Chairman Marshall of the Committee of Award traced the development of chemical engineering to its present status of recognition as a branch of the engineering profession. He showed the part played by the universities, by the American Institute of Chemical Engineers, by the periodical and book literature and by the Engineers Council for Professional Development.

After Messrs. duPont and Robinson had expressed their thanks on behalf of the duPont company as a whole and the Organic Chemicals Department in particular, Mr. Robinson delivered an address in which he stressed the importance of group effort in building an organic chemicals industry in the United States. Excerpts from that address follow:

▼ ▼ ▼

Building for the Future

By EDMUND G. ROBINSON

General Manager,
Organic Chemicals Department,
E. I. duPont de Nemours & Co.,
Wilmington, Del.

IT WAS a particularly happy thought of *Chemical & Metallurgical Engineering* to make this award to a group instead of to an individual. In the development of an organic chemical industry and of products like DuPrene and synthetic camphor many individuals must contribute their share to the research, the design, the construction and the plant operation, each of which is an essential step in the commercial development. This has meant that not only the Organic Chemicals Department but other departments of the du Pont company as well deserve to be recognized for their share in this achievement. The Chemical and Engineering Departments, in particular, have contributed no small part to bringing the manufacture of these products to a successful commercial scale.

The du Pont company has long recognized the essential contributions which the chemical engineer can make, which in fact no one else can make, to the development of the chemical industry. The expansion of the chemical industry in this country and the growth of the chemical engineering profession are as intimately connected as the chicken and the egg. Those of us who received our college training in chemistry in the early years of this century will remember that in those days "chemical engineering" was an unknown expression. In the short

time which has elapsed since then there has been a continual and rapid growth in the recognition of the part which chemical engineering plays in the practical application of the processes devised by the research chemist.

The first major entrance of the du Pont company into the organic chemicals industry was in 1917. After considerable study of the situation which had been revealed by the World War, the du Pont company decided that it was essential that this country be freed from the dominating grip of the foreigners in this respect. It is not necessary to waste time describing the extent to which, theretofore, American industry had been dependent upon foreign sources for necessary dyestuffs and other organic chemicals. That is an old story to all of you. Suffice it to say that the du Pont company, recognizing that this industry was important in many ways to the national welfare, and that it could be successfully entered only by a company able and willing to invest very large sums of money, started at that time the enterprise which has grown into its present Organic Chemicals Department and which has made possible developments of which DuPrene and synthetic camphor are the typical examples recognized by your Committee of Award.

DuPrene is not rubber in the specific sense, but is a product which for many purposes is superior to rubber and is today gradually being used for more and more commercial purposes, for which its peculiar properties make it particularly suitable. Much has been said about its superior resistance to oil, gasoline and many other solvents as compared with natural rubber, but its exceptional resistance to flex-cracking and oxidation are of even greater importance from the point of view of the rubber technologist. Because of these properties it has replaced natural rubber for many purposes and has created also new markets for the rubber industry since it can be used for purposes for which natural rubber is totally unsuitable. Perhaps there is less general recognition of its great resistance to oxidation and to flex-cracking. This product will be used in manifold places where the elasticity of rubber is required but, where due to the conditions of exposure, the life of natural rubber is too short.

Striving Toward Lower Costs

Chemical engineers can readily appreciate the difficulties of designing production-scale apparatus of satisfactory design, materials and methods of control, efficiently to carry out on such scale a series of reactions which on paper may look extremely simple. When to these natural difficulties is added the requirement that yields, labor efficiencies, and power consumption must be such as to produce the finished product at a very low cost, the problem becomes great indeed. With a new plant which has been completed this year it has finally been possible to increase our production to equal the growing demand of the rubber manufacturers. It will be our policy to expand production as necessary to meet increasing requirements and we confidently believe that with the progress which has been made in the development of the process, this can be done. Moreover, it has been our policy to sell DuPrene at prices based, not upon the current cost of manufacture, but upon costs which we expected to realize.

We are confident that the group of chemists and engineers who have already contributed so much to the establishment of our synthetic rubber industry will go much farther in the future with the result that we will be able to reduce the cost of DuPrene to rubber manufacturers to such a degree that it may displace natural rubber to a very large extent. All of us are striving toward this goal and we suspect that the ultimate result may exceed even our most sanguine expectations.

Camphor an Engineering Problem

The development of synthetic camphor which the Committee has also seen fit to mention especially in connection with this award is another example of the result of the application of chemical engineering to the problem of carrying out on a commercial scale and on an economical basis a synthesis in which the chemical steps are comparatively simple. Many processes have been used to manufacture synthetic camphor and very large sums of money have been spent but until the last three years no commercial success had been attained in this country. This problem is particularly complicated as a result of the complex nature of the terpene compounds involved and the difficulty of avoiding the formation of objectionable byproducts which would lower the quality of the finished product and be difficult to eliminate. The camphor which we have succeeded in producing on a scale to satisfy the requirements of the Tariff Law is, we are told by the trade, equal in quality to any other camphor on the market. Thus is completed another step on the long road of making America free from foreign domination.

Perhaps the most striking conclusion which we have reached as a result of our experience with chemical industry is the thought that no matter what chemical effect you desire to produce, some organic chemical can be found if you search long enough. Sometimes minute quantities will produce the desired effect. The enormous coloring value of many organic coloring materials, and the great potency of many organic compounds when used as medicinals are the classic illustrations. Newer developments, however, serve further to emphasize this remarkable versatility. The rubber industry has been revolutionized by the discovery of the effect of fractions of a per cent of organic compounds in accelerating vulcanization, reducing the deteriorating effects of light and air, and otherwise lengthening the life of rubber. Similar small quantities of organic chemicals added to gasoline and to lubricating oil serve to prevent gum formation in the gasoline or to increase the value of the lubricant when used in bearings under extreme pressure. The textile industry has had its problems greatly simplified by all sorts of textile assistants—organic chemicals which facilitate the fundamental operations of textile manufacture by causing more rapid wetting, by increasing dispersion or by similar effects.

It is obvious then that an organic chemical industry is a source of continual developments in the form of new aids to other industries and that its scope is limitless. It is equally obvious that the existence of such an industry is an essential factor in our national life. The new products and materials produced by organic chemistry enter our daily lives in a multitude of ways producing truly better things for better living.

Chemical Plant Construction of the Present

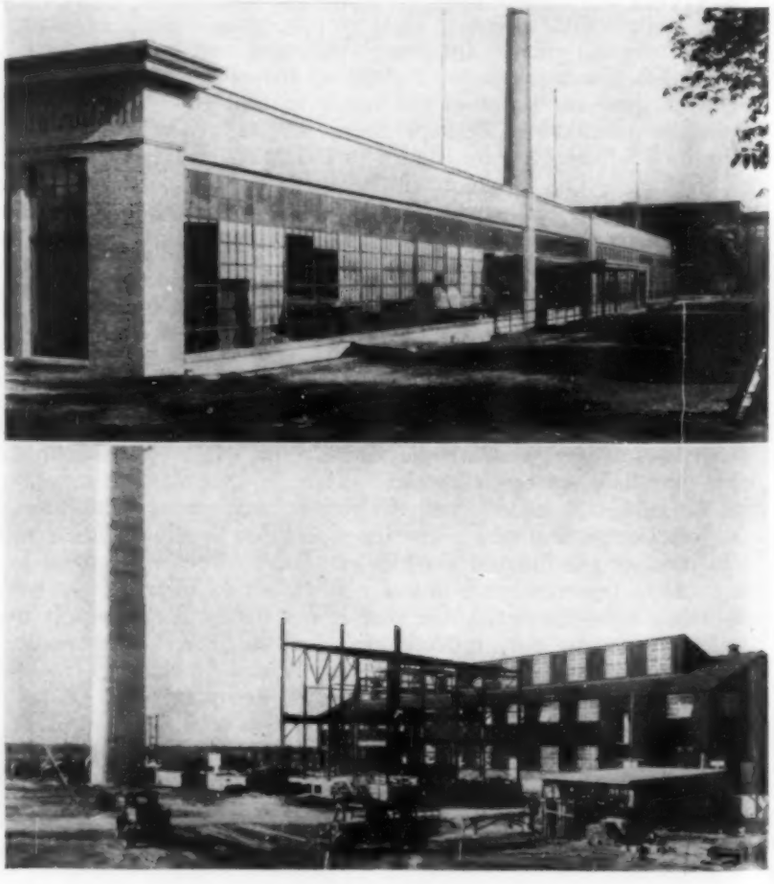
New and better materials are now available but opportunity still exists through research to be assured of safe foundations, dense concrete, impervious brickwork and non-corrosive metals as essential to house the chemical industry

WERE WE TO LOOK at the chemical plant of 25 or 30 years ago we would be impressed with the heavy walls, the few scattered windows, and the massive appearance throughout. There was a logical reason for these heavy walls—they supported the floor loads and by their own weight withstood wind pressures. Today this same industry is housed in a building of open steel frame with light walls and daylight construction. The style has changed, but the ancient materials are still in evidence—brick, stone, wood, mortar and iron products. Realizing that more new building construction during the past few years has involved the chemical industry than any other single industry, it is only proper that we consider recent developments in these basic building materials and point out some needed improvements in chemical plant construction. These items will be treated from the standpoint of the construction engineer. The chemical engineer will be looked to for help in improving the products which are fundamental in the building industry. He should also be in a position to assist materially in the development and production of new types of construction materials.

Many changes in building construction have come about through experimental approach rather than through scientific research. Builders have usually had an idea that certain materials or methods would be the answer to their problems and have tried to prove that they were right rather than study the problems with an open mind. Research in building materials has a long course to travel before it reaches the consumer. To perfect an item of construction is not enough—it must be adaptable. Perhaps this is the main reason why, over a period of years, we have seen revisions in the design rather than in actual materials.

The correct determination of the building site is, of course, intimately related to soil conditions. Having settled on the economical location, with full consideration of future expansion, labor and material markets and other essentials, the engineer is confronted with the problem of soil investigation. He cannot take a chance on carrying heavy loads on uncertain foundations. Today equipment has been developed at Ohio State University capable of determining the nature of the subsoil and within close limitations the depth to which piling need be driven to carry loads safely. With apparatus available, which

Top—Sheet metal cornice and wall panels with continuous steel sash present permanent appearance but permit possible extensions. Bottom—The chemical engineer chose wood sash for this new plant



Based on a paper, The Relation of Research to Chemical Plant Construction, presented before A.I.Ch.E. at Columbus, Ohio, Nov. 15, 1935.

and Future

By **HURLBUT S. JACOBY**
Director of Industrial Research
Ohio State University
Columbus, Ohio

Chemical plant equipment requires special building design but walls and roof offer opportunity for standard materials

two men can set up within an hour, you will know ahead of time whether the site requires piling, what soil is present at various depths and what over-all cost is involved. We are approaching the time when costs of work under the ground surface will be on the same definite basis as the balance of the building.

A colorful foundation condition exists in Mexico City, the entire area of which lies over an old lake bottom. With the soft silt and water underlying the surface to a depth of several hundred feet, there are no skyscrapers in evidence. Even two-story buildings have sunk and become badly cracked and out of alignment. The impressive National Theatre with its massive marble walls has sunk several feet and settled unevenly to such an extent that it was necessary to excavate anew and landscape around the outside of the building to its assumed elevation. Confronted with the problem of designing foundations for the International Telephone and Telegraph Co. equipment building several years ago, it was soon determined that the only feasible foundation was a solid reinforced concrete mat resting on the only good soil close to the surface. This mat covered the entire building area and extended out in a cantilever beyond the building walls. It was interesting to note that the load testing platform previously employed rested on a column of small cross section which punched through the subsoil and assumed a tilting position, the identical condition experienced with many buildings in Mexico City today.

Most persons have believed that next to rock nothing could be more secure than to rest a basement floor on shale. When it was noticed that partitions in the basements of some of the buildings of the General Electric Lamp Works in Cleveland were pressing against the ceilings to form a letter S, it was thought that the ceiling above was deflecting due to the superimposed floor load. But large cracks in concrete stairs indicated that enormous pressures were being exerted and upon investigation it was found that the floor elevations above were undisturbed, but that portions of the basement floor had actually raised as much as one foot. Digging through the concrete floor resting on a cinder fill, the shale for a depth of at least ten feet was separated into finely divided laminations. Investigations proved conclusively that oxidation of pyrite had caused this condition; that the entrance of air through the cinder fill, with resulting expansion in layer by layer of the shale over a period of 15 to 20 years, had exerted this pressure and caused the damage. We have not all of the answers to this problem, but it appears evident that in future instances the surface of freshly excavated shale should immediately be sealed against the entrance of air, and that no cinder or other porous fill should be used under the concrete floor.

Although various cements have been developed to resist chemical action and constant wear, the prime essential for successful concrete work is to secure the proper mix of cement, water and aggregate. Sloppy concrete was rightly named, which, with its abundance of water, brought all the impurities and foreign matter to the surface—the identical location where the finished concrete was subjected to the hardest service. During the past few years the water : cement ratio has demonstrated its value in producing a denser and stronger concrete and at less cost. Research engineers are busy at Ohio State

With the walls and ceiling intact, this basement floor was lifted one foot by oxidation of iron pyrite in the underlying shale

utilizing vibration in the placing of a relatively dry concrete. Thus far we believe that the vibrator with high frequency and low amplitude and immersed in green concrete gives the best results. It is highly important that the vibrations do not carry over into concrete that has started to set, thus destroying the very thing that we hope to accomplish, namely, a dense concrete.

All of these improvements have brought about a stronger concrete with less cement—a lower cost product, it is true, but one which, simply because of the reduced amount of cement, tends toward voids and through voids tends toward leaks and cracks. Research is demonstrating that a certain proportion of finely divided clay, as fine or preferably finer than the cement itself, and thoroughly mixed with the cement, will reduce the voids in the finished concrete, giving an impervious result without the use of an excessive amount of cement. The strength is not impaired and the same density is secured as is usually gained through the addition of cement. Although few structures require the handling of large masses of concrete, it might be that the special low-heat, slow-setting portland cement and the principle of dissipation of heat may result in reducing or eliminating cracks in concrete with resulting unsightliness, leaks, and deterioration.

As an example of the importance of tight floors, it is interesting to learn that the caustic liquors gradually seeping through the concrete floor of a building constructed for the Hooker Electrochemical Co. nearly 20 years ago has, through crystallization which occurred in the ground, raised some of the footings and columns as much as eight inches.

Another fertile field for further research in concrete is in the direction of improving its low tensile strength. The strength of concrete in tension is a very small part of its strength in compression. If this could be raised to a point where tensile stresses 20 or 25 per cent of those allowed in compression could be safely employed, the field of usefulness of concrete would be extended.

The first thing that one is reminded of in connection with brickwork is leaky walls. Engineers have tried all types of mortar joints and have experimented with various ingredients. Most of the cases of water penetration through 9 and even 13-inch walls are puzzling. In many cases the vulnerable point is not immediately opposite the evidence of moisture on the inside—apparently the water has traveled inside the wall. There is room for considerable experimentation and research in this connection. This is probably one of several construction items where it might be well to return to former practice—in this case to resort to the specifications which were followed before cement was added to lime mortar with the resulting shrinkage leaving hair-line cracks at the joints. At the same time, I am not unmindful that masons today do not shove joints and exercise the care that they did years ago.

De-airing, or the evacuation of air, particularly from clay products, has been placed on a commercial basis during recent years. With equipment now on the market, it is quite possible to make a stronger brick with smoother edges and corners and a reduction of 50 per cent in the absorption of moisture. Ohio State University is not the parent of de-airing, but as Dr. Bole, head of ceramics research, has said, "We were present at the birth." Many other building products have been improved by de-airing—even putty has been strengthened, rendered denser and more adhesive. It is conceivable that de-airing concrete will give the impervious floor that we seek to attain in the chemical plant.

The brick wall has enjoyed the favor of the building department and the fire underwriters. Although the hollow brick wall with the air enclosure has several advantages in moisture and sound proofing and lower cost, its use is restricted to exterior and secondary walls. The contractor experiments with brick. He tries hard shale brick to get a weatherproof job and backs up the parapet wall with shale brick or mastic coating, only to find that the softer lime brick which takes up moisture will also give it up, and that this brick will form a better bond with the mortar without adjacent hair cracks. Glass brick, particularly for inside partitions, offer very interesting possibilities.

Building Framework

The building framework of rolled steel shapes has many points in its favor—simplicity of initial construction and future expansion, ease of attachment of equipment and pipes, minimum interference in clearances and lighting and possibility of reinforcement to carry unforeseen heavier loads.

In the tendency of the bulky and impressive building of the past giving way to the light and sleek structure of the present, the welded steel frame plays an important part. Here we have extreme simplicity with resulting economy. As a rule, two members can be joined together without the use of a third, thus saving material and weight. In a truss-type building the steel saving is often as much as 25 per cent. In a typical 40-ft. plate girder in which approximately 70 pieces need to be riveted together with a total weight exceeding five tons, there are now one-half the number of pieces to handle in an equally strong welded girder weighing slightly more than four tons.

Progress in welding is handicapped by details which

have been required for riveted work. The steel mills could help materially by rolling sections which are peculiarly adapted to welding design. Tubular sections will be in favor rather than the angle used in riveted members.

Although windowless factories are now being built to house certain manufacturing operations, it is doubtful that this type of construction will appeal to the chemical engineer. In addition to the abundant light and ventilation necessary, he recognizes the advantage of a broad expanse of steel sash when changes and expansion are necessary, and realizes the danger to building and men in case of explosion within a solid brick wall enclosure.

Non-Condensing Sash

Steel sash is in evidence in nearly all chemical plants of recent construction. True, the sections have been reduced in thickness over those first put on the market, but the cost is so reasonable and the installations so simple that many plant engineers prefer to replace after a period of years rather than use heavier sections or resort to wood sash. With the thin members and square corners prevailing in commercial steel sash, it is highly important to see that any joints anchored into brick walls are thoroughly bedded in mastic and that all exposed steel is well protected with proper paint. Intimately related to window sash is the item of window glass. An insulating window glass or a method of installing glass so as to be non-condensing and free from drip would be useful. This applies to the condensation of moisture out of the air as well as oil or other vapors which tend to make the window lights opaque.

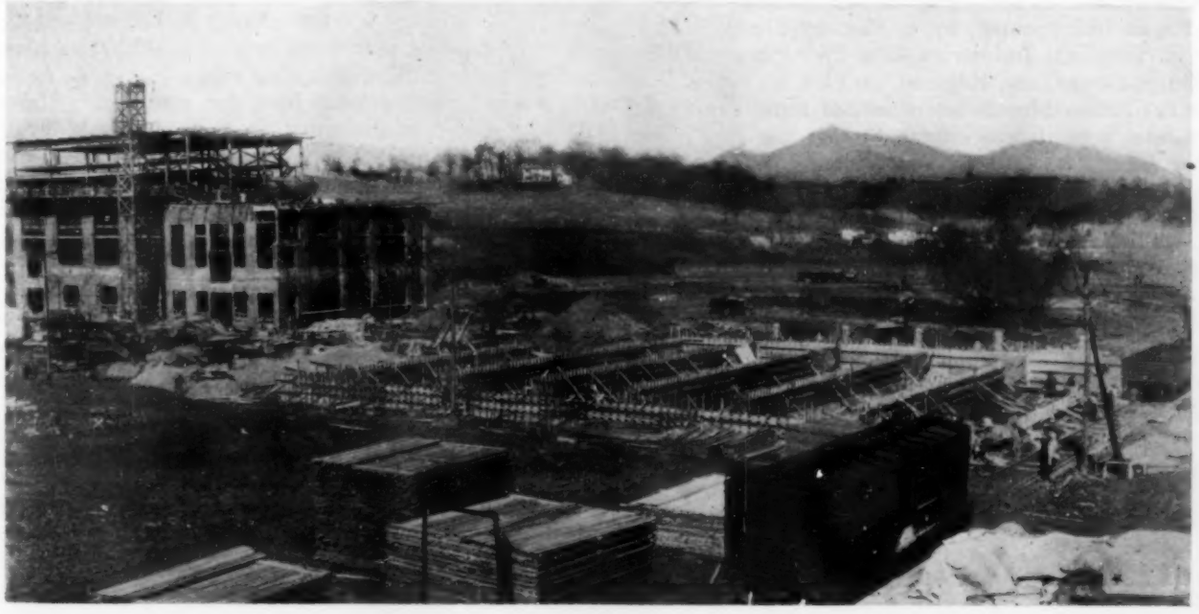
Many different materials and combinations of materials have been developed for the roof and wall enclosures of chemical plants. For the sloping roof where light construction with provision for altering and expansion is advisable, we turn to the corrugated asbestos sheet consisting of equal portions of asbestos fiber and portland cement formed under great pressure into a homogeneous sheet. With its light gray color, this material reflects the light inside the building and the heat on the outside—it is non-combustible, resistant to most chemicals and when fastened to the steel frame with non-corrosive metal clips requires little maintenance.

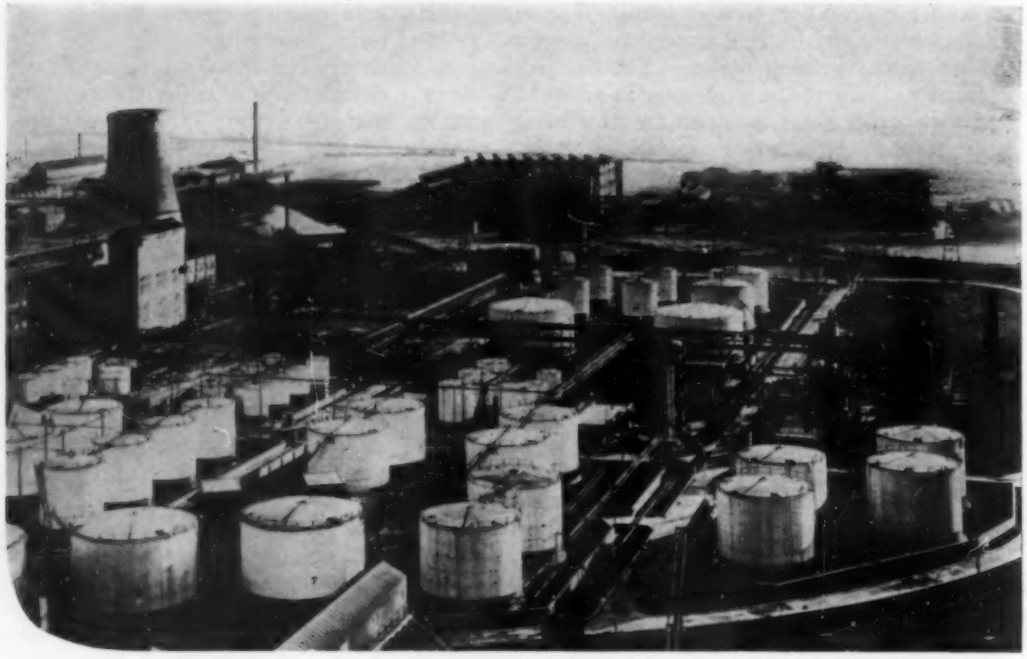
With the successful development of plastic materials in other fields, it is probable that some day there will be available a roofing and siding board perhaps coming from the universally usable and valuable soybean. This might give a light weight roofing material that can be laid on a flat or slightly sloping surface that requires no painting and little maintenance under extreme conditions. There is room for new solid fireproof units of lighter weight and with enough elasticity to prevent cracking.

Rapid strides have been made by the steel mills in sheets of special composition. Some of these will have so little iron in them that they cannot properly be called steel, but they will be rust-proof and definitely resistant to corrosion. In addition to the simple and quick erection possible, more floor space results because of the thin walls. All of these materials lend themselves to standardization. The building which houses the special equipment and unusual manufacturing techniques of the chemical industry does not lend itself to standardization, but I am confident that a standard will be possible for the walls and roof. And in this connection we might rightly expect more tolerance in building codes. Why should we require more in the exterior wall than we get in wired glass?

With all its shortcomings, wood is the most accessible and adaptable of all building materials. For certain types of occupancy, the timber frame with its slow burning property is more desirable than structural steel. The chemical art has discovered means of making lumber proof against decay and shrinkage. An added treatment might conceivably render wood immune to destruction by fire. There is no doubt but that the weight of lumber in a structure can be materially reduced by the intelligent use of non-corrosive metal joints.

Exposure to the weather for weeks before construction makes the control of concrete mixtures difficult





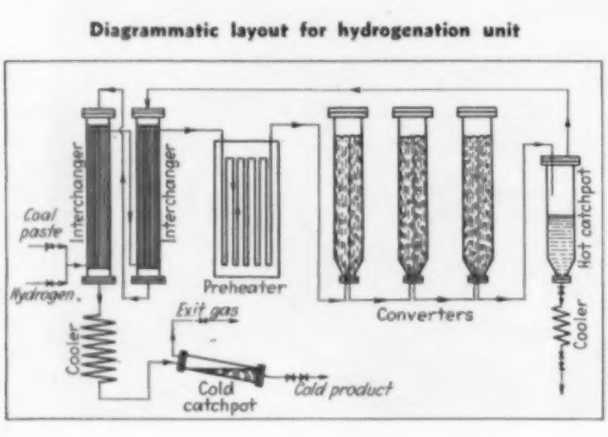
General view of tank farm and coal hydrogenation plant of Imperial Chemical Industries, Billingham-on-Tees

COAL HYDROGENATION AT BILLINGHAM

By LONDON CORRESPONDENT
Chemical & Metallurgical Engineering

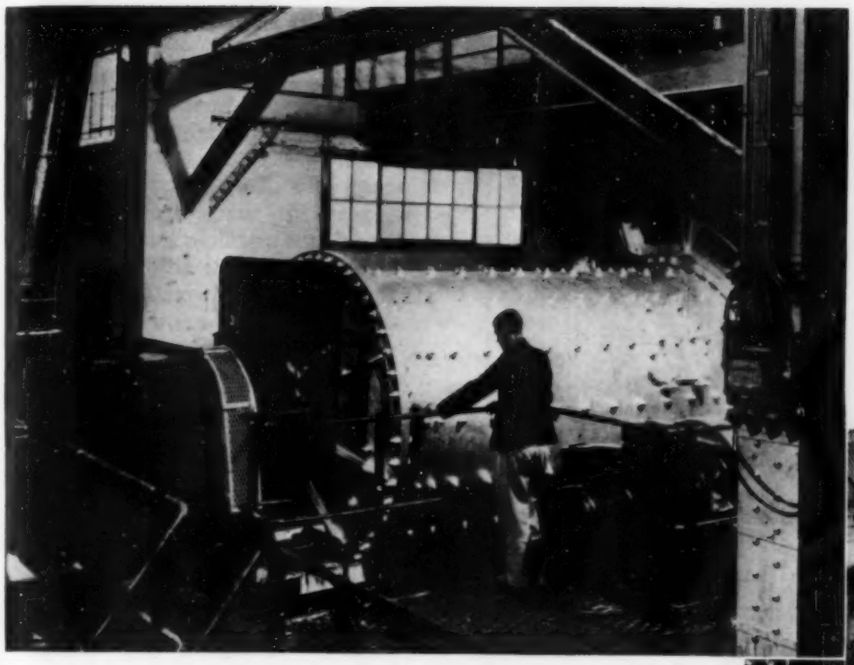
COMMERCIAL scale hydrogenation of bituminous coal became an accomplished fact for the first time with the formal opening, by J. Ramsay Macdonald, of Imperial Chemical Industries' coal hydrogenation plant at Billingham-on-Tees, England, on Oct. 15. The occasion was signalized by the attendance of some 300 notable guests to whom it was explained that the new plant, although it can produce at present capacity only 4 per cent of England's gasoline supply, nevertheless makes it technically possible for the country to become self-sufficient as regards petroleum products, with the present exception of certain lubricating oils.

Diagrammatic layout for hydrogenation unit



Although the Germans have for some years successfully produced motor spirit from brown coal, the new I.C.I. plant is the first one to produce gasoline through the hydrogenation of bituminous coal. When the plant reaches full production it will produce 30,000,000 imperial gallons of gasoline annually from coal, with an additional 15,000,000 gal. from various tar products. The latter are not essential to the process but may be conveniently hydrogenated with the coal. The process is capable of turning 60 per cent by weight of the clean coal processed into high quality gasoline but is sufficiently flexible to produce also fuel oil, diesel oil, and liquefiable hydrocarbon gases such as propane and butane. It is a self-contained process, requiring only coal and water as raw materials.

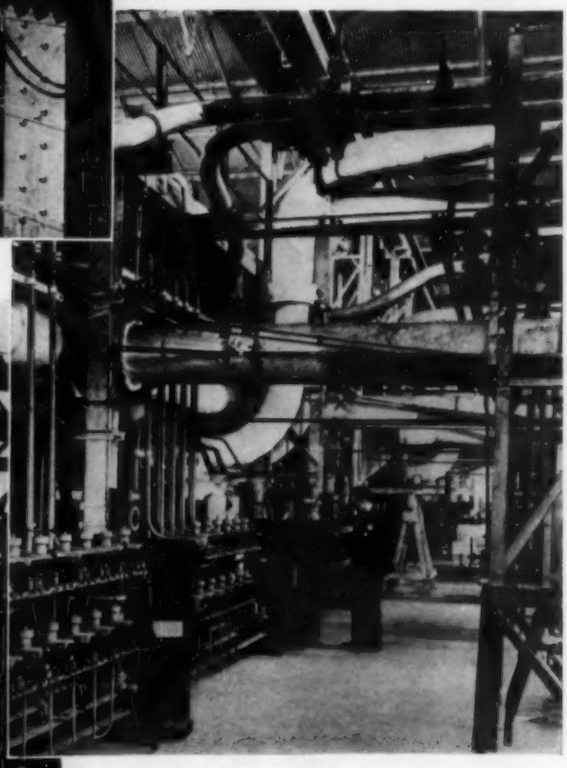
Experimentation at Billingham on the hydrogenation of coal has been continuous since 1927. A successful pilot unit treating 15 tons of coal a day was operated in 1930 and 1931. In the latter year an agreement was

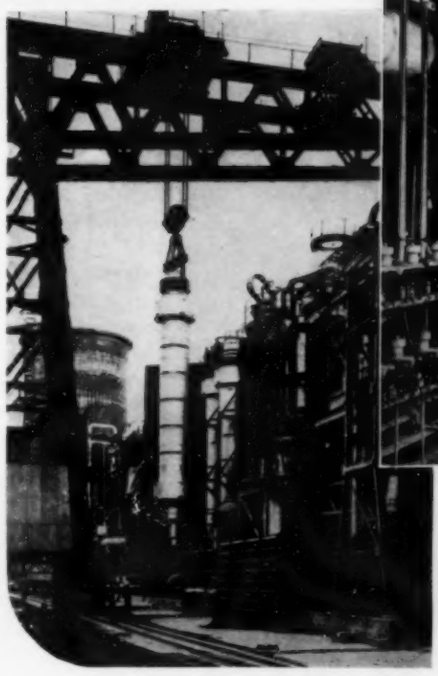


Left: One of the grinding mills where coal is ground in oil to a fine paste

Below: Part of the hydrogenation plant, showing high-pressure valves and instruments

Center: One of the converters being lowered into position

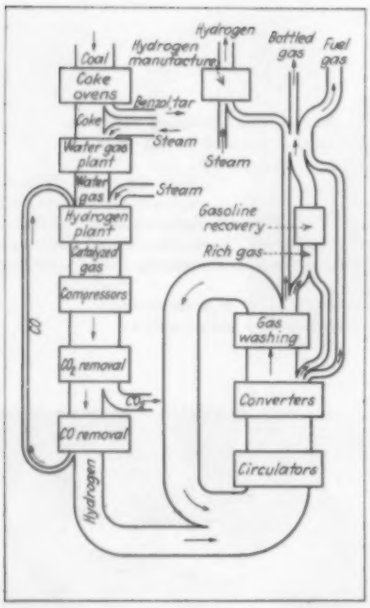




reached with other operators in the hydrogenation field, including the I.G. of Germany, the Standard Oil Co. (New Jersey) and the Royal Dutch Shell Co., resulting in the formation of the International Hydrogenation Patents Co. to pool patent rights and exchange technical information. Meanwhile, experimentation continued until, in 1933, the British government passed a bill guaranteeing a preference, for a period of years, on home-produced light oils. I.C.I. immediately launched a construction program, completing the first section of the plant in January, 1935. This first section operated on creosote oil. The first coal unit was started in June, 1935, and output is expected to reach rated capacity before the end of this year. At the time of the formal opening, 40,000 tons of gasoline had already been made, of which 27,000 tons had been shipped for distribution.

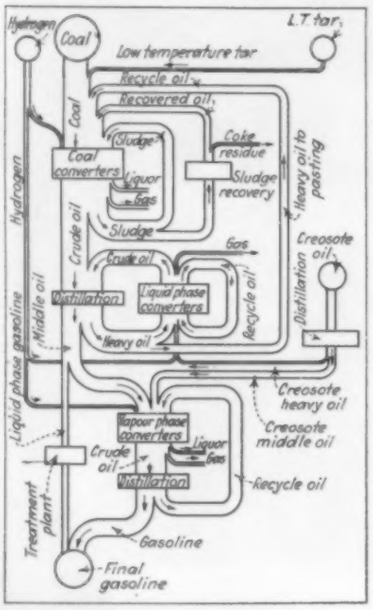
Gasoline contains 85 per cent carbon and 15 per cent hydrogen, whereas in coal 85 parts of carbon are associated with only 5 parts of hydrogen. In producing liquid and gaseous hydrocarbons from coal, therefore, it is necessary to add hydrogen under conditions of high temperature and pressure. Using coal as a raw material, a yield of gasoline between 60 and 70 per cent by weight is obtained. Using low-temperature tar and creosote oil, which contain 85-90 per cent of carbon and 7-8 per cent of hydrogen, the gasoline yield is between 80 and 90 per cent.

Hydrogen for the process is made by the decomposition of steam by means either of coke or the residual hydrocarbon gases from the process. Raw coal, which has been cleaned to contain less than 2½ per cent ash, is ground with oil previously made in the process to a 50 per cent coal-in-oil "paste." This paste is passed through high-pressure injecting apparatus which pumps it up to the conversion pressure. It is mixed with hydrogen and the mixture heated to the reaction temperature. Liquefaction of the coal takes place at 850 deg. F. and 250 atmospheres pressure. A small heavy-oil fraction containing the unconverted coal (5 per cent by weight) and the ash is treated for oil recovery and the coke residue used as a fuel. The major part of the coal is trans-



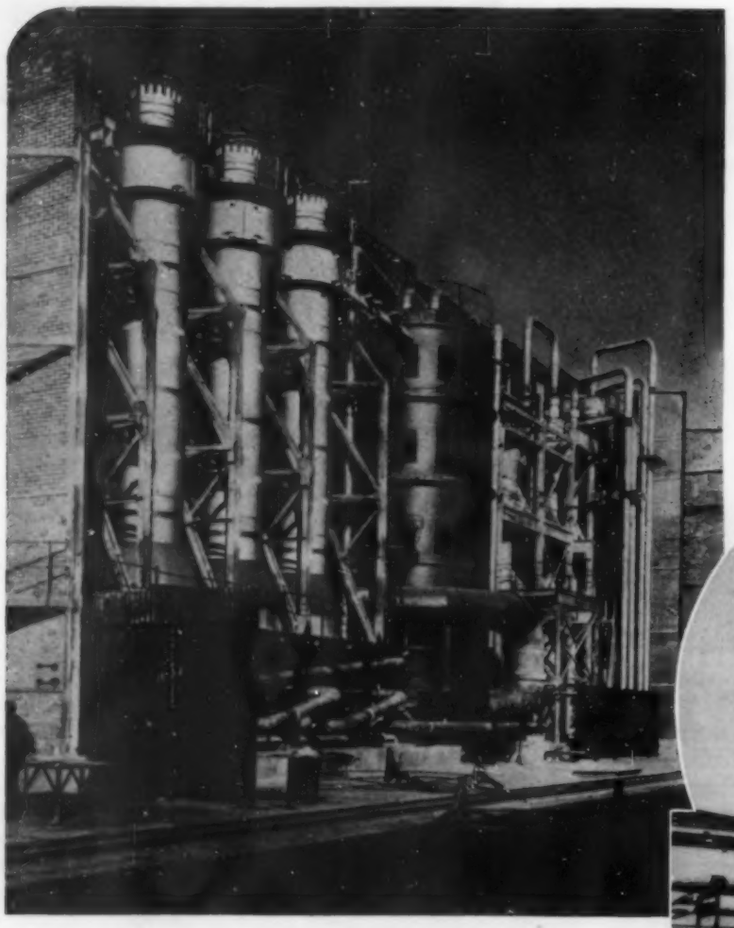
Flow diagram showing hydrogen production steps

Flow diagram of three-stage hydrogenation process



formed into lighter oils which are vaporized and recovered on cooling the gaseous products leaving the converters. The crude oil so obtained is distilled into heavy oil, middle oil and gasoline. Heavy oil is further hydrogenated in a plant exactly similar to that used for the hydrogenation of coal, yielding middle oil and gasoline. Middle oil resulting from these two steps is further hydrogenated in vapor-phase converters where the vaporized light oil and hydrogen are passed over a solid catalyst. The crude vapor-phase product is distilled, the residual middle oil being separated from the gasoline and treated again. The coal is thus converted into a small solid, consumable residue, gas and gasoline.

Creosote oil and low temperature tars are either employed for making up the coal paste, or distilled, and the fractions introduced into the liquid- or vapor-phase stages. After a simple purification the final gasoline is pumped to storage tanks from which it is shipped by steamer to the oil companies with which marketing arrangements have been made.



Hydrogenation unit with three converters at the left and, at the right, catch pot and heat exchangers

Distillation equipment for fractionating hydrogenated products

Producing Phenolic Resins For Molding

IN THE Hemco Molding Division of the Bryant Electric Co. almost every commercially available synthetic resin is formed into a great variety of products, such as electrical connections, telephone parts, tableware, and trays. With one exception the resins used for this purpose are received at the Bridgeport, Conn., plant in the form of powder ready for the presses. The single exception is the phenolic resinoid which is produced at the Hemco plant. Due to the large number of modifications of this resin required in the extensive molding division of the company it has been found more satisfactory to produce the resin on the premises, where the varying requirements of the molding department may be promptly met.

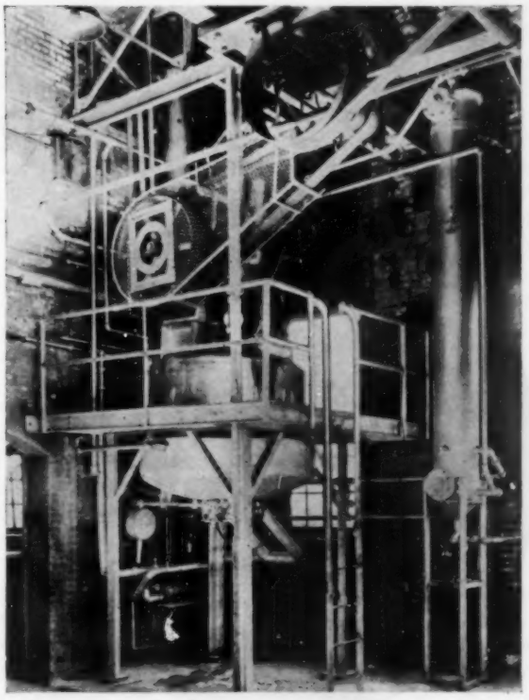
The phenol-formaldehyde resin plant is modern in every respect. Nickel and aluminum have been used in the construction of certain pieces of the equipment in order to prevent corrosion and darkening of the resin by contact with iron surfaces. The phenol is stored outside the building in a steel tank equipped with steam coils, while the formaldehyde is kept in an aluminum tank placed in shed to protect the contents from the cold weather. A two-days' supply of phenol is stored in tanks beneath the floor of the processing building.

The resin is prepared in a pressure kettle, the lower portion of which, where the charge is held, is equipped with a jacket for steam heating and water cooling. A power-driven agitator projects through the center of the digester cover. Above the digester is a 30-ft. reflux condenser equipped with a series of nickel tubes and nearby is the outside condenser. Pressure and vacuum gages, with necessary control valves, are attached to an inlet of the digester.

The equipment for grinding the resin and mixing with it the various other materials required in the molding powder consists of Sullivan crushing mills, ball mills, Baker-Perkins dry mixers, and steam heated roller mills, which look like small rubber mills. The ball mills are enclosed in a sheet-iron case and all of the other grinding and mixing equipment is located under hoods. These precautions are taken to prevent the finely divided particles of resin and filler from escaping into the rooms.

A charge should only consist of enough raw materials to occupy about one-third the total digester capacity. This is advisable on account of the vigorous nature of the reaction and the consequent ebullition that takes place when the condensation has started. About equal volumes of phenol and formaldehyde and pumped into the digester and 0.1 per cent of hydrochloric acid is added to catalyze the reaction. The ratio of phenol to formaldehyde is varied to meet the requirements of the resin desired.

Steam is passed through the jacket to start the reaction, but as the reaction proceeds the steam supply is gradually reduced and finally shut off entirely. During the reaction,



A phenol-formaldehyde resin production unit in plant of Hemco Molding Division, Bryant Electric Co.

which requires about two hours, it is necessary to keep close watch over the temperature so that it will not exceed about 220 deg. F. While the reaction is going on the reflux condenser is used.

At the end of the reaction the valve to the reflux condenser is closed and the outside condenser is opened and the vacuum connected. At this point the temperature of the batch drops and it must be held between 125 and 175 deg. F. with the assistance of steam in the jacket. The water layer formed during the reaction is drawn over to the outside condenser by vacuum and the condensed vapors drain into the sewer. Six hours are required to free the resin of the last trace of water.

At this point the hot liquid resin is drawn off, through the valve in the bottom of the digester, into the galvanized iron cans and allowed to harden. Two days are necessary to cool the resin. It is then dumped out on the floor, broken up with sledge hammers, and the lumps are crushed in the Sullivan mills. After crushing, the resin is put into ball mills, where the proper additions are made, the hardening agent (hexamethylenetetramine), lubricant (calcium or zinc stearate, or montan wax), and neutralizing material (lime). The whole mass is then given a thorough grinding and mixing, whereupon the pulverized material is transferred to the dough mixers where fillers (cotton or paper flock, asbestos, slate, and starch) and coloring are added; from ½ to 1 hour is required for proper mixing.

Suitable batches of the powder are then treated on the steam heated two roller mills where the mass is worked into a solid mass called the blanket. After cooling, the blankets are passed through a Sullivan crusher where they are broken into pieces about 1 in. square. This broken material is then pulverized in a crusher equipped with a cyclone dust collector and resinous powder is then ready for molding.

Left—Single creped paper lining asphalted to burlap. Right—Double creped paper lining cemented with asphalt

Paper-Lined Textile Bags For Your Products

By R. W. LAHEY
American Cyanamid Co., New York, N. Y.

Combinations of paper and textiles have been so cleverly devised as to uplift a drab but extremely useful article to the point where it can compete with more colorful and more expensive types of containers

THE INGENIOUS EFFORTS of bag manufacturers to broaden the market for their products can be plainly seen in the combinations of paper and textiles which have been so cleverly devised. This work has uplifted a drab but extremely useful article to the point where it can compete with the more colorful and more expensive types of containers.

These developments are the result of many years of hard and often discouraging work. They represent a large investment in research and testing. Business in general can profit from the story of the intensive efforts for product improvement which has been crowned with success only through the untiring work and the optimism of the men who have accomplished it. Interesting anecdotes can be related of inventions and patent protection, but we are concerned with the available types of these bags, their uses, and their good and bad features.

Some powders are likely to sift excessively even when packed in bags made of closely woven cloth. Other products absorb or give off moisture and therefore must have more protection from the atmosphere than is afforded by textiles, while still other materials must be kept free from the slight contamination of jute, cotton fibers, or foreign materials.

In order to overcome these disadvantages manufacturers of textile bags began by lining their bags with plain kraft paper. This scheme was unsatisfactory because the paper lining was apt to break. However, in 1898 crêped paper first appeared on the market, which marked the beginning of an era of development. Today, we have two main types of bag linings; namely, loose paper liners and those laminated to textile bags.

Think what would happen to your product if 100 lb. were packed in a loose paper liner without any other protection. After this package has been filled and closed it is probable that the first attempt to move it would result in failure of the liner and loss of the product. It is therefore readily admitted that the liner obtains its strength from its supporting element, the textile bag. With this basic principal established, we can readily construct certain features which a proper liner must possess. The liner must be able to bend, flex and stretch in unison with the outer bag so that the latter will absorb all shocks and strains. To accomplish this the liners must fit perfectly into and closely follow the contour of the outer container. In addition, they must be able to equal or better the stretch of the textile bags in all directions and finally they must be properly closed or folded over. It is therefore evident that extreme care must be used in the choice of size, insertion of liner into the bag, and the filling and closing of the package.

Loose liners fall into two general classifications, *i.e.*, the single-stretch and the double-stretch type. Single-stretch liners have about 33 per cent stretch around the width of the bag and no stretch is provided in the direction of the length. Double-stretch liners have approximately 33 per cent stretch in both directions. The stretch feature, aside from the care exercised in insertion, filling and closing the container has more bearing on the performance of the liner than any other item. To avoid placing strains on the liner, its minimum stretch must equal the stretch of the outer textile bag in every direction. An attached illustration shows that the stretch of 8 oz. burlap bags in the direction of the porter and the shot varies from 3 to 4 per cent while the stretch on the diagonal is about 28 per cent.

Kraft paper, ranging in weight from 25 to 50 lb., is first crêped in the roll; then cut to size and the seams are folded and machine sewed with a double locked stitch through four thicknesses of paper. In the last few years the seams of some liners have been pasted with rubber latex or other waterproof adhesive, thereby eliminating the sewing. Recently liners have been made with seams on both sides and no bottom seam. This improves the strength of the liner as the bottom sewing is a point of weakness.

Crêped or crinkled kraft paper has been treated with different coatings in order to incorporate into the liners resistance to transmission of moisture and grease. Crêped paper may be waxed or treated with other compounds or two sheets may be laminated together with asphalt or other resinous materials in various amounts. Their resistance to moisture depends on the ability of the protective films to flex and stretch with the paper and the outer textile bags.

In order to display some products better, liners are sometimes made of blue kraft paper. The blue background enhances the whiteness of the product.

Attached is a tabulation showing some of the materials which are packed in textile bags with loose liners. This indicates general practice in the industry and one can be guided accordingly in the choice of containers.

The efficiency of the liner is dependent on the care in handling to a much greater degree than almost any other container in use. If the following instructions are not carefully adhered to, it is probable that the time and money spent for liners will be partially wasted.

It is evident that the fit of the liner must be carefully determined. The width after crêping should be equal to the width of the outer bag. Therefore a bag that measures 24 in. "after made" requires a liner 24 in. wide "after crêping" and after made. To avoid misunderstandings it is good practice to quote either cut size or after made size of the outer bag to be fitted. With the textile bag size given, manufacturers can determine the exact size of lining necessary and they will thereby accept the responsibility for a proper fit.

The liner should always be longer in length than the outer bag. The following general rules can be used in determining liner length:

Outer bags 15 to 25 in. long—add 2 in. for liner length.

Outer bags 25 to 35 in. long—add 3 in. for liner length.

Outer bags over 35 in. long—add 4 in. for liner length.

It is much better practice to have liners a little too long than too short.

Products packed in textile bags lined with loose or cemented paper liners

Quantity packed in a bag varies from 5 to 200 lb. Textiles are of many weights and constructions from 7½ to 14 oz. burlap and from 7¼ yd., 30 in. width cotton sheeting to 7 oz. osnaburg

Aluminum powder
Ammonium acetate
Ammonium sulphate
Asphalt powder
Boiler compound
Borax
Calcium chloride
Calcium phosphate
Cattle feeds
Cement compound
Charcoal
Chemicals—general
Clays
Coffee
Cork
Drugs
Dry colors
Fertilizer
Fertilizer nitrates
Floor compound
Gelatine
Glue
Gypsum concentrate
Graphite
Furnace cement
Insecticides
Lead whiting
Magnesium
Malt
Meals
Meat
Mineral feeds
Moss
Nitrate of potash
Nitrate of soda
Pigments
Plaster
Powder
Powdered buttermilk
Powdered coal
Powdered sweet milk
Quick lime
Rosin
Salt
Silicate
Sodium bicarbonate
Spice
Sugar—brown
Sugar—granulated
Sugar—powdered
Sulphur
Superphosphates
Talc and clay
Tanning extracts
Tea
Tobacco powder

The insertion of loose paper liners into the outer textile bags is an important operation. This must be done so that there will be no strains exerted on any part of the liners when the bags are filled. Of course the vulnerable spots are the two bottom corners. If by any chance these corners are folded over, strains on the liners will result and they are apt to rupture. A sure method of properly inserting liners is to use a form somewhat similar to the attached illustration. The liner is drawn over the form, making sure that the two ends of the form fit snugly into the corners. The textile bag is then drawn over the liner and both bag and liner are removed. Care must be taken to be sure that in removal from the form the liner does not slip. In removing the paper lined bag, grab the center of the bottom of the bag and pull towards the bag mouth. This will tend to push the bottom corners of the liner into the proper position in the bag corners. The container may then be filled with assurance of a perfect fit of both liner and bag.

Closing the outer bags and the liners are other important operations. The liners should always be closed separately from the outer bags, as any closure of the outer bags which includes the liner is likely to cause strains and breakage of the liner.

The liner can be folded with two 1-in. folds and then pressed down without tying, or it can be tied with wire or twine. If the latter method is used it should be tied as close to the mouth as possible and then pressed down inside the outer bag. The outer bag may then be machine sewed, hand sewed or wire tied. Closures must be so designed that the closure of the inner liner will rest against the outer bag; therefore better results can be

obtained with a machine or hand-sewed outer bag if the liner is folded to conform to the shape of the closure.

Sometime after the discovery of the loose paper liner, work was started on laminating crêped paper to burlap and cotton, using asphalt as an adhesive. This process has gradually been developed and refined. At the present time there are several different types of paper-lined bags for the shipper to choose from. These containers are obtainable with either single or double crêped paper linings.

There are two methods of attaching the paper linings to asphalt. One is to coat crêped kraft paper of between 20 and 30 lb. weight with asphalt by use of a doctor blade and then pass the paper and the textile through two calendar rolls which press the two materials together.

The other plan is to coat the plain kraft paper with asphalt and then crêpe it by use of knives before it is attached to the outer textile. This method allows the insertion of crêping in two directions.

Bag material with paper laminated to the cloth is made into bags in almost the same manner as regular cloth bags. The seams are at the side and bottom and the edges are doubled back and the regular double locked stitch is used, through four thicknesses of material.

One important difference in the construction of plain and lined bags is that the latter need not have the selvage of the material at the mouth of the bag as the adhesive will not allow raveling of the raw threads. This provides more latitude in choice of size and sometimes a slight saving in price can be effected.

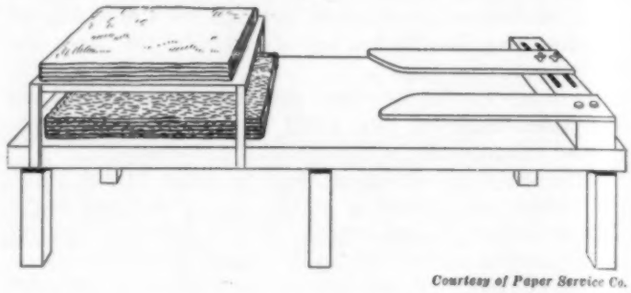
As explained in the previous article on plain textile bags (*Chem. & Met.*, vol. 42, p. 544), handling strains are usually exerted against the porter threads, but if the raw edge of the cloth is at the mouth of the bag these strains will be exerted against the shot threads. This will somewhat reduce the strength of bags made of light weight (7½ an 8 oz.) burlaps as the tensile strength of the shot threads is not as great as that of the porter. On the other hand, it will increase the strength of the heavier burlaps (10 oz. and up) as the tensile strength of the shot threads in these constructions is greater than that of the porter.

In order to accommodate those products where sifting and moisture transmission occurs through the needle holes, some manufacturers have pasted crêped paper gussets on the inside of the longitudinal folds and bottom seams of the bags, while others have covered the seams on the outside with rubber-coated or crêped asphalt laminated tape.

Paper-lined bags have several advantages over the bags with the loose liners, although somewhat higher in price. In the first place, the problem of insertion of the liner with the extreme care required for the proper insertation is eliminated. Further, it is not necessary to close the liners separately. They will stand abuses of transportation with less liner breakage, and the material used for laminating adds to the tensile strength of the burlap due to the fact that it lubricates the threads,

Table for inserting loose liners

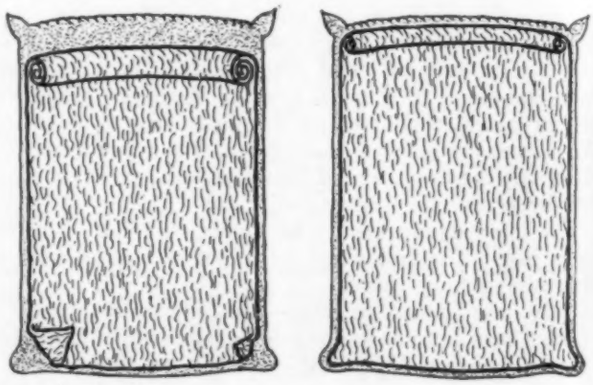
Loose liners can be quickly and accurately inserted with this equipment. Arms should fit snugly into liner and bag



Courtesy of Paper Service Co.

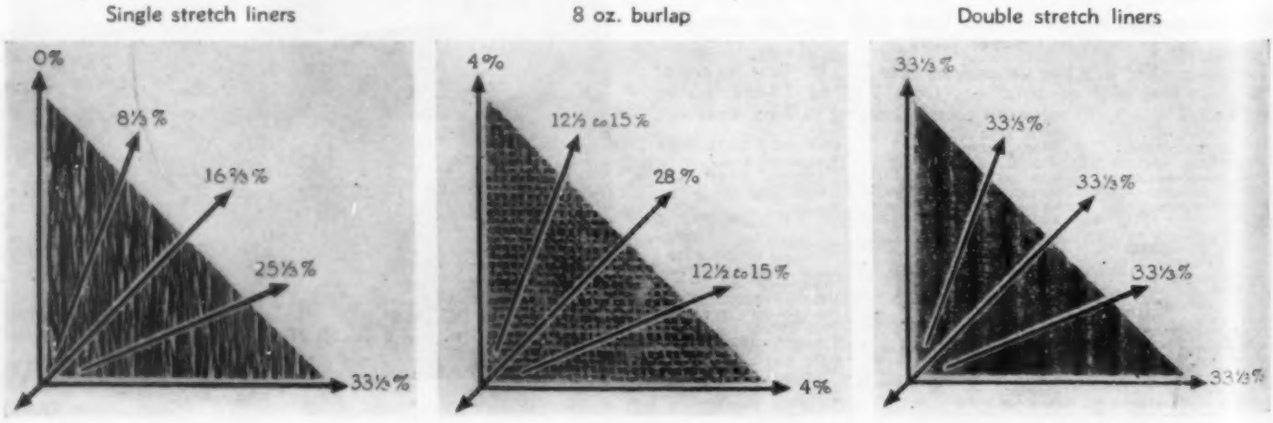
Cross section of inserted loose liner

Left—Liner has been rolled down too far and it is doubtful if it can stretch and unroll to conform to outer textile bag. If it does not liner will break. Right—A properly inserted liner which rests against textile bag at all points



Burlap compared with loose or cemented paper liners

Stretch is given in per cent. Diagonal stretch is important as handling strains are exerted in the diagonal direction

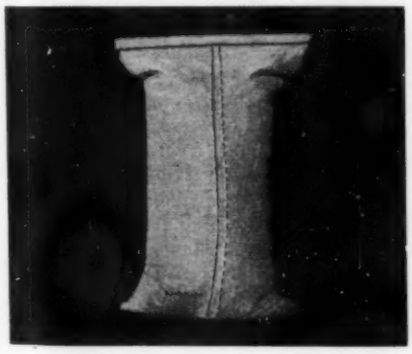


thereby reducing friction. Although some types of these containers are harder to close because of stiffness, the double operation of closing (liner and outer bag) is eliminated.

An ingeniously designed bag with attached paper liner was introduced a few years ago, and its rapidly increasing popularity is almost entirely due to the fact that it eliminates the difficulties of the loose liner. This container consists of an outer textile bag with a paper liner containing stretch in all directions. The liner is attached to the burlap with vegetable or animal glue or rubber latex. It is flexible, extremely easy to close, and the liner prevents sifting of the contents. Hygroscopic materials cannot be packed in this bag as it contains no protection from moisture. Some of these bags are so designed that the paper liner can be removed, thus enhancing the salvage value of the used container. It is also obvious that this container combines two separate items in one, thus helping to simplify purchasing, handling, and stocking of containers.

The latest and by far the best and most important development in construction is the pasted seam, using rubber latex as an adhesive. This eliminates all sewing on the bags as they can be closed by pasting tape with latex over the mouth. The best longitudinal seam is made by using a 1- to 2-in. lap at the center of one flat side of the bag. As the pasting must be done by using a burlap-to-burlap contact, the paper liner must be set back from one edge of the cloth and overhang on the opposite edge. The bottom is seamed by the use of a tape which consists of two outside plies of burlap, between which are layers of adhesive-paper-adhesive. Burlap coated with rubber on one side is also used for this purpose. It is best to use tape 2½ in. wide so the adhering surface on each side will be at least 1 to 1⅛ in. The tape should extend over the bottom ends by at least ½ in. at each side and should be firmly cemented with rubber latex. It is not desirable to have the bottom tape extend over the side of the bag any further than absolutely necessary as these hard surfaces may cause chafing and ruptures in shipment.

Pasted Seam Bag



Center seam is 1 in. lap of burlap and inner liner offset to cover textile lap.

Bags of this type can be closed by sewing, wire tying, or cementing tape with latex over the mouth of the container. There are a couple of machines on the market which will successfully effect this pasted tape closure. It is the opinion of many that this is an outstanding bag development, and full advantage of this container has not been taken by the consumer.

Perhaps more important is the successful effort of a bag manufacturer to insert as much stretch in the paper liners as there is in the textile covering. The importance of stretch in loose liners previously discussed applies equally to the attached liners. All bag makers have been able to provide some stretch in the second direction, but for really effective containers enough stretch to equal the stretch of the burlap is required in all directions. This has been fully covered in the discussion on loose liners.

There have been some important improvements in the adhesive used for attaching the crêped paper to burlap. Asphalt is commonly used for this purpose because it is more moisture resistant than most other coatings. Asphalt, however, has several physical properties which are a handicap to its use—namely, brittleness in extreme cold, very low percentage of stretch, and softening and staining burlap in hot weather. Bag manufacturers have long been working to eliminate these bad features and they have made considerable progress. Combinations of different types and kinds of asphalt and the use of some other materials with asphalt have been found to give the best results.

One manufacturer has devised a novel method of improving these conditions on double-lined bags. He uses rubber latex as the adhesive between the outer burlap and the first paper lining. The adhesive between the two layers of paper is asphalt and as it cannot come in contact with the burlap, he is able to use a lower melting point variety. The bags therefore do not become stained and they are more flexible, and as a result are easier to fill and close, and more moisture resistant.

Although a large improvement has been made in the

Closures for Paper Lined Bags

1. Hand sewed bag with loose liner. 2. Textile bag with wire tied closures. 3. Machine sewed closure effective for both types of liners. 4. Cemented tape closure.

adhesive, there still remains room for further betterments, particularly in the matter of stretch. It is admitted that paper-lined bags can be purchased with adequate stretch to prevent rupture of the lining unless the outer textile bag is torn, thereby preserving the sift-proof and contamination-proof qualities while the outer burlap is intact. None of these bags, however, have enough stretch in the adhesive to equal the stretch of the burlap and paper under handling conditions and therefore the resistance to moisture transmission must be carefully checked before adoption.

There are some other types of bags on the market but they are not important from the standpoint of volume. In some cases rubber coatings of various types have been applied to the outer textile coverings. Bags have been made of burlap covered on both sides with paper, using asphalt or other materials as the adhesive. Liners are coated with wax or paraffin to prevent rotting of containers used for materials of an acid nature.

It can be easily seen that these modern sift-proof, contamination-proof, moisture, resistant containers have progressed a long way from the ordinary burlap bag. These developments, and there are many more under way, have all come in the last few years and the possibilities of their use have not been exhausted. The additional protection which they afford the material packed, places these bags in a class where they can compete with the more expensive containers. Their cost is so much less that it is plainly the duty of all shippers to investigate the possibilities of adopting them for obvious economic reasons. If the reader has not kept abreast of these new developments he is due for some surprises.

▼ ▼ ▼

American Chemical Engineers To Join in World Conference

By A. E. MARSHALL

Chairman, American Institute of Chemical Engineers Committee on Arrangements

CONSIDERABLE progress has been made in the development of the program for the International Chemical Engineering Congress, June 22-27, 1936, in London and with arrangements for the subsequent joint meeting of the American Institute of Chemical Engineers and the British Institution of Chemical Engineers.

The Chemical Engineering Congress is to be an international gathering with its first day, Monday, June 22, devoted to organization of divisions and to the making of acquaintances. The four succeeding days will be devoted to an extensive paper program sub-divided as follows: (1) Chemical engineering projects, (2) Chemical engineering plant construction, (3) Fuel, heat and general problems in chemical engineering, (4) Administration and works organization in chemical engineering, (5) Trend of development in chemical engineering, and (6) The organization of research and the translation of research to industrial production.

The International World Power Congress is sponsoring the International Chemical Engineering Congress and at the request of the American national committee of the World Power Conference, an A.I.Ch.E. committee was appointed to solicit American papers under the above outlined heads, and to act as local clearing house on Congress matters.

The sub-committee is pleased to report that it has been successful in securing a representative set of papers from members of the American Institute of Chemical Engineers and other authors and it believes the United States will be well represented as far as the caliber of paper contributions is concerned.

The four-day technical session, while primarily devoted to reading and discussion of papers, may also include afternoon excursions to plants or points of interest in and around London, although this point has not been definitely settled at the present time.

The members of the Institute of Chemical Engineers attending the Congress will join with the British Institution of Chemical Engineers in an eight-day tour of the British Isles, the present arrangements contemplating the starting of this program either on June 28 or 29.

Because of the four-day technical session preceding this joint meeting, no attempt will be made to include technical matters as part of the joint meeting program, rather it will take on the character of a social gathering.

The travel plan for the joint meeting is being arranged so that termination of the tour comes at Liverpool, as the Society of Chemical Industry has scheduled its annual meeting at Liverpool July 6-11 inclusive, and has invited the American chemical engineers to associate with it in the meeting.

This Liverpool meeting will undoubtedly provide visiting members of the A.I.Ch.E. an opportunity to inspect several of the important chemical plants conveniently located to Liverpool and the meeting will also furnish Institute members with an opportunity of renewing acquaintances with members of the Society of Chemical Industry who took part in the 1928 Canadian-United States tour.

Plans for these three successive gatherings, all distinct as to organization, would permit return either at the conclusion of the joint meeting with the British Institution or at the conclusion of the Society of Chemical Industry meeting, and additionally the British Institution's Committee has advised us that it has made arrangements with an English travel agency so that visitors could include some Continental travel in their itinerary.

The matter of transportation to and from England has engaged the attention of the Committee on Arrangements of the American Institute of Chemical Engineers. At the November Council meeting in Columbus, Ohio, it was decided the tentative arrangements which had been made with the Cunard Steamship Co. should be confirmed and that the outgoing passage should be on the S.S. "Samaria" sailing from New York June 12, as this sailing date permits arrival of the members in London a day or so before the opening of the Chemical Engineering Congress. It is hoped that the majority of the members attending the English meetings will travel on the "Samaria" as such travel can be made at a saving over independent steamer bookings and, additionally, there will be no obligation to return on any specific Cunard steamer, thus giving flexibility to the return program.

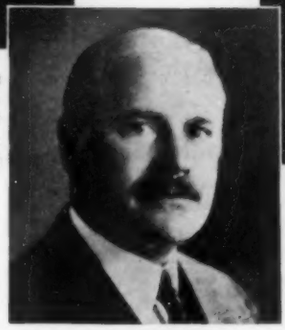
A.I.Ch.E. Meets at Columbus

EDITORIAL STAFF REPORT

Martin H. Ittner, chief chemist, Colgate-Palmolive-Peet Co., recently elected president of the Institute

Fred C. Zeisberg of the development department of E. I. duPont de Nemours and vice-president of the Institute

Carl R. DeLong, consulting engineer for Amusol Corp., and treasurer of the Institute



Frederic J. LeMaistre, reelected secretary and executive secretary

OHIO proved a generous host and provider for the enlightenment, as well as the entertainment of the 350 members and guests of the American Institute of Chemical Engineers who attended the 28th annual meeting in Columbus November 13, 14 and 15. Continuing a practice inaugurated two years ago, a well-attended and enthusiastic student meeting preceded the general conference. Prof. James R. Withrow, head of chemical engineering at Ohio State University, headed up a large group of committees that represented not only the Columbus chemical engineers but those from the industries of the entire state.

Most interest from the standpoint of the society, centered in the announcement by Pres. Albert E. Marshall of plans for the European meeting in the spring of 1936 which will be held in connection with the International Chemical Engineering Congress. Mr. Marshall's report appears on the preceding page. Much interest also centered in the announcement of the election of the new officers: Dr. Martin H. Ittner, chief chemist, Colgate-Palmolive-Peet Company, president; Fred C. Zeisberg, development department, E. I. duPont de Nemours & Co., Inc., vice-president; Carl R. DeLong, treasurer; Frederic J. LeMaistre, secretary and executive secretary. The new directors elected were: Edward Bartow, head, department of chemistry and chemical engineering, State University of Iowa; Dr. Gustav Egloff, director of research, Universal Oil Products; Albert B. Newman, professor of chemical engineering at Cooper Union; and James G. Vail, vice-president, Philadelphia Quartz Co. Abstracts of a number of the technical papers, other than those published in full in this issue, are to be given in the following pages.

The opening technical session was on applied chemical engineering. E. E. Slowter, F. B. Hobart of Battelle Memorial Institute and James R. Withrow, head of the department of chemical engineering at Ohio State University, presented a paper on experimental cracking of a gas oil in fused metal. There is a difference of opinion in the literature as to the catalytic effects of certain metals (notably tin) in the thermal cracking of petroleum. A gas oil of 35.8 deg. Bé., an I.B.P. of 442 deg. F., and an end point of 672 was cracked in tin, lead and steel shot baths. The cracked liquid product was analyzed by distillation. No difference existed in the cracked products obtained from equal depths of the various baths. However increasing the depth of any of the baths decreased the temperature of optimum production of gasoline and increased the optimum gasoline yield slightly, for single-pass cracking. For recycling, lower temperatures apparently produced more gasoline than higher temperatures, provided a sufficient number of cycles were made. The cracked gases from fused baths were of approximately the same composition as those from various other high-temperature cracking processes. It was concluded

that neither tin nor lead possessed catalytic effects in cracking petroleum and that for present practice there is no desirability in cracking temperatures higher than those now actually in use.

Fluid flow in clear round straight pipe was discussed by Benjamin Miller of Cities Service Co. of New York. He showed how much of the uncertainty could be avoided in the use of experimental data correlated in the past by the use of a simple diagram. This diagram, he said, permits a direct solution for the rate of discharge and has a demonstrated accuracy of 95 per cent.

Separation of Solvents and Water

Separation of solvents and water in refining and dewaxing of lubricating oils was the subject of a paper by Eugene R. Smoley and Wheaton W. Kraft. There has been rapid development in processes employing solvents for the production of high-quality lubricating oils from crude petroleum, the authors stated. These processes include solvent refining and solvent dewaxing. Solvents used commercially at the present time include: acetone, aniline, benzol, chlorex, cresylic acid, carbon tetrachloride, ethylene dichloride, furfural, methyl-ethyl ketone, nitrobenzene, phenol, propane, liquid sulphur dioxide and toluol. The characteristics of these solvents have been analyzed and their effect on the choice of the process to be employed for solvent-water separation in solvent refining and dewaxing plants has been indicated.

In general, fractional distillation appears to be the most suitable method of separating water and solvents because of its adaptability to solvent recovery systems and the familiarity of the refiner with this type of equipment. It is necessary to study each problem and then decide which process is most suitable. A bibliography of solvent properties was prepared.

Hydrogenation of Distilled Spirits

Hydrogenation of freshly distilled spirits was discussed by C. A. Hochwalt, C. A. Thomas and E. C. Dybdal of Thomas & Hochwalt Laboratories. The natural aging of whisky can be considered to occur in two operations: (1) the removal of the unpleasant odors and tastes, known as greenness found in the freshly distilled liquors, and (2) a maturing process, principally a natural chemical esterification and polymerization, which imparts a mellow taste and body to the liquor. The natural aging process can be accelerated by removing the greenness chemically. This chemical method consists in treating the whisky by reduction with hydrogen, which changes the compounds responsible for objectionable greenness of whisky into odorless and tasteless bodies.

Vapor-phase hydrogenation as well as other reduction methods that have been used for this purpose were discussed and results reported. In the vapor-phase hydrogenation the fresh whisky vapors are treated with hydrogen in the presence of a metallic catalyst such as nickel or platinum. The hydrogen-treated vapors are then led into a separator in which the excess hydrogen is removed from the condensed vapors and used for treatment of fresh stock. The condensed degreened vapors are subsequently aged in the usual manner. The process is continuous and operating costs are extremely low.

Various methods of catalytic hydrogenation of freshly distilled spirits were investigated. Vapor-phase hydrogenation at 100 deg. C. in the presence of a nickel catalyst gave the best results from both the standpoints of ease of plant operation and quality of product.

Platinum black or finely divided nickel proved to be effective catalysts in the vapor-phase, but since nickel was found to be quite as active and is much less expensive it was selected for plant operations. Included in this very interesting contribution to the more rapid aging of spirits was a complete description of the equipment and operation procedure employed in the process.

By replacing the water used in steam boilers with Dowtherm A a greater power yield can be attained from each ton of coal burned, according to G. G. Brown, G. A. Gaffert, P. H. Konz and D. S. Ullock of the University of Michigan. The data presented by the investigators supplies the information needed in the design of boilers and power units utilizing the new boiler fluid. The report stated that the most important present use for the new substance is in an intermediate section of a special boiler between the actual fire and the steam boiler and that in this way a much greater power yield can be obtained from the fuel burned without producing excessive pressures. Savings are being effected in its use both in the initial investment in the power plant, the cost of whose boilers is a fraction of that of similarly efficient steam plants, and in the amount of fuel consumed per horse power hour of power output.

The influence of small concentration of air in steam on the steam film coefficient of heat transfer was discussed by S. J. Meisenburg, R. M. Boarts and W. L. Badger of the University of Michigan. The effect on the steam film coefficient of known amounts of air in the steam used to heat a vertical tube was studied, as a result of which it is concluded that the Nusselt equation with a suitably modified constant and the addition of a term for the air concentration. Prof. Badger and Jesse Coates followed with a paper on the effect of viscosity on coefficients of heat transfer in forced circulation evaporators.

Several papers presented at the meeting appear in full elsewhere in this issue of *Chem. & Met.:* Industrial medicine and industrial toxicology by Dr. G. H. Gehrmann, medical director of E. I. duPont de Nemours & Co.; Calculation methods of countercurrent leaching by E. M. Baker of University of Michigan; and the relation of research to chemical plant construction by Hurlbut S. Jacoby of Ohio State University.

Other Developments

Among the other papers delivered at the meeting were: Some recent developments of photographic applications by Dr. Walter Clark of the Eastman Kodak Co.; Extraction of acetic acid with isopropyl ether in a spray column by J. C. Elgin and F. M. Browning of Princeton University; Equilibrium absorption of carbon dioxide by solutions of the ethanolamines by Jesse W. Mason of University of Florida and B. F. Dodge of Yale University; Heat transfer coefficients during drop-wise condensation of steam by W. M. Nagle, G. S. Bays, L. M. Blenderman, T. B. Drew of Massachusetts Institute of Technology; and Conditions for drop-wise condensation of steam by Nagle and W. Q. Smith and Controlled atmospheres for the heat-treatment of steel by H. W. Gillett of Battelle Memorial Institute.

Simplifying the Calculation of Countercurrent Extractions

By **EDWIN M. BAKER**
Professor of Chemical Engineering
University of Michigan
Ann Arbor, Mich.

IN 1917 and 1920 L. F. Hawley of the Forest Products Laboratory in Madison, Wis., published two excellent papers (*J. Ind. Eng. Chem.*, **9**, 866-71, 1917, and *ibid* **12**, 492-6, 1920) on the theories of successive and countercurrent extraction. It is the purpose of this paper to present extensions of the Hawley equations which are more broadly applicable to problems arising from time to time in countercurrent extraction. The Hawley equations for countercurrent extraction and those to be presented here are based on certain assumptions, some of which are common to both. The assumptions involved in the two developments are:

1. That in any cell or extraction vessel in which solid to be extracted and solvent are brought into contact, all of the solute passes into solution and the composition of the solution is the same throughout. This is equivalent to stating that equilibrium between solution in the pores of the solid and the solution surrounding the solid is presupposed to be attained in each extraction cell. This assumes no adsorption of solute by the solid.

2. At the completion of an extraction or boiling period, wet solids and a solution of solute and solvent are separately withdrawn from the cell.

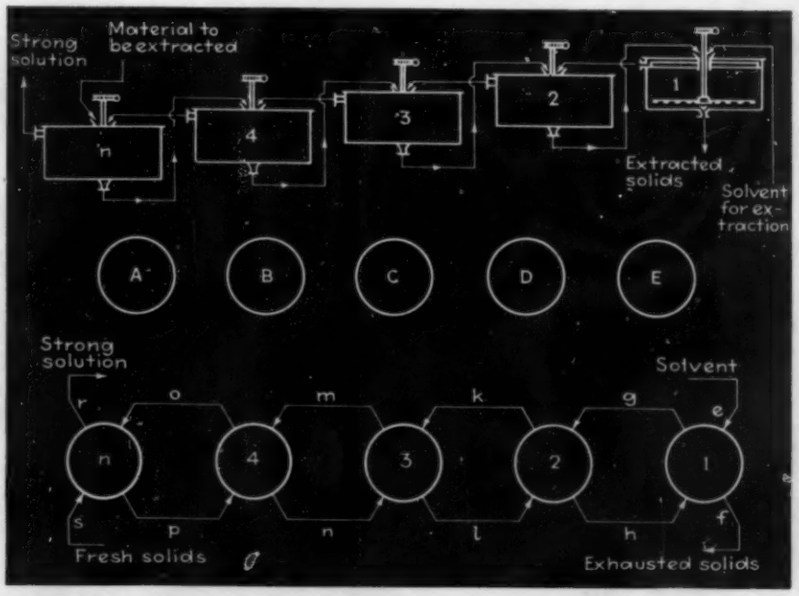
According to the first assumption the ratio of solute retained by the solid to that present in the solution withdrawn from the cell would be the same as the ratio of solvent retained by the unextracted solid and solvent withdrawn as solution. It is assumed that there is no entrainment of solid in the solution withdrawn from the cells. Hawley designates this ratio by the letter a and the same nomenclature will be used here. Except for certain special cases, Hawley assumes this ratio to be a constant in all cells of the extraction battery. The major formulas to be derived in this paper do not make this second assumption.

Two general cases will be considered here.

Case 1: Continuous Countercurrent Extraction—This type of extraction is exemplified by a battery of Dorr thickeners. In a battery of Dorr thickeners a thick mud is withdrawn from the bottom of one thickener and a clear liquid is withdrawn from the launder at the top of another thickener. These will be referred to as "underflow" and "overflow," respectively. These are brought together in a thickener located between the two. Thus, in Fig. 1, overflow from thickener 2 and underflow from thickener 4 are brought together in thickener 3, yielding a new underflow which goes to thickener 2, and overflow which goes to thickener 4. A battery of Dorr thickeners is clearly continuous in its operation. The same type of operation might, however, be secured with other apparatus.

Case 2: Batch Countercurrent Extraction—In Fig. 2 there is shown diagrammatically an extraction battery consisting of three cells in which the extraction process is in progress, together with other cells which are not at the moment in operation. At the start of the cycle cells A, B, and C are in operation. Cell A contains the most nearly exhausted solid and cell C contains the least extracted solid. A fourth cell, D, is now filled with fresh solid. The solution in cell C is withdrawn and passed into cell D. The solution in cell B is withdrawn and

Fig. 1—Battery of Dorr thickeners arranged for continuous countercurrent extraction to yield strong solution and extracted solids
Fig. 2—Diagrammatic arrangement of batch extraction tanks
Fig. 3—Continuous countercurrent extraction battery showing flow lines



Presented by the author under the title of "Calculation Methods of Countercurrent Leaching" at the Columbus, Ohio, meeting of the American Institute of Chemical Engineers, Nov. 15, 1935.

passed into cell C. The solution in cell A is withdrawn and passed into cell B and fresh solvent is added to cell A.

After sufficient time has elapsed to allow the solution in each of the several cells to come into equilibrium with the solution held by the respective solids, strong solution is withdrawn from cell D as a product of the operation. The solution in cell C is then transferred into cell D, the solution in cell B is then transferred into cell C, and the solution in cell A is transferred into cell B. No fresh solvent is added at this stage of the cycle. The exhausted solid in cell A is then removed. A new cell E is now filled with fresh solid, and after equilibrium is attained in cells B, C, and D the cycle described above is again repeated, with cell E filling the rôle of cell D of the previous cycle. It will be observed that there are two movements of solution from one cell to the next for each cycle, and that solvent is added and solution is withdrawn for only one of these two movements. In batch countercurrent extraction, therefore, as distinguished from continuous countercurrent extraction, two equilibriums are attained for each cell in active use in the battery.

Case 1—In Fig. 3 there is represented diagrammatically a continuous countercurrent extraction battery. This may consist of any number of cells, though, for example, the diagram shows five cells numbered 1, 2, 3, 4, and n. The underflows are indicated by the letters s, p, n, l, h, f and the overflows by the letters r, o, m, k, g, e. Fresh solids, s, are shown as introduced into cell n as underflow and strong solution r is shown as withdrawn from this cell as overflow. Exhausted solids f are shown as leaving cell 1 as an underflow and solvent e is shown as entering cell 1 as an overflow. The fresh solid is, of course, accompanied by the solute which it is desired to extract, and may or may not be also accompanied by some solvent. Solvent introduced into cell 1 may or may not contain some solute as the case may be. The exhausted solids withdrawn from cell 1 will, of course, contain some solvent and some unextracted solute.

Let x equal the weight of solute in the solution leaving on the exhausted solids from cell 1, stream f. Let c equal the weight of solute in the "fresh" solvent entering the system as stream e going to cell 1. Also, let a_1, a_2, a_3, a_4, . . . a_n equal the ratio of solvent drained off, to solvent retained in the respective cells. It will then be apparent that

$$g = a_1 x \tag{1}$$

since the amount of solvent in the overflow from 1 is a_1 times the solvent in the underflow.

By a material balance over unit 1, it follows that

$$k = a_1 x + x - c = x(1 + a_1) - c \tag{2}$$

By the same reasoning as used in writing equation (1) it follows that

$$k = a_2[x(1 + a_1) - c] = x(a_2 + a_2a_1) - ca_2 \tag{3}$$

By a material balance over both units 1 and 2

$$l = x(a_2 + a_2a_1) - ca_2 + x - c = x(1 + a_2 + a_2a_1) - c(1 + a_2) \tag{4}$$

In like fashion:

$$m = x(a_3 + a_3a_2 + a_3a_2a_1) - c(a_3 + a_3a_2) \tag{5}$$

$$n = x(1 + a_3 + a_3a_2 + a_3a_2a_1) - c(1 + a_3 + a_3a_2) \tag{6}$$

$$o = x(a_4 + a_4a_3 + a_4a_3a_2 + a_4a_3a_2a_1) - c(a_4 + a_4a_3 + a_4a_3a_2) \tag{7}$$

$$p = x(1 + a_4 + a_4a_3 + a_4a_3a_2 + a_4a_3a_2a_1) - c(1 + a_4 + a_4a_3 + a_4a_3a_2) \tag{8}$$

$$r = x(a_n + a_n..a_4 + a_n..a_4a_3 + a_n..a_4a_3a_2 + a_n..a_4a_3a_2a_1) - c(a_n + a_n..a_4 + a_n..a_4a_3 + a_n..a_4a_3a_2) \tag{9}$$

$$s = x(1 + a_n + a_n..a_4 + a_n..a_4a_3 + a_n..a_4a_3a_2 + a_n..a_4a_3a_2a_1) - c(1 + a_n + a_n..a_4 + a_n..a_4a_3 + a_n..a_4a_3a_2) \tag{10}$$

Since s is the weight of solute entering the system on the fresh solids, the fraction of solute so entering that is not recovered* is

$$F = x/s = 1/(1 + a_n + a_n..a_4 + a_n..a_4a_3 + a_n..a_4a_3a_2 + a_n..a_4a_3a_2a_1) - \frac{c}{x}(1 + a_n + a_n..a_4 + a_n..a_4a_3 + a_n..a_4a_3a_2) \tag{11}$$

In many extraction problems, the solvent ratios for all units except that containing the strongest solution may be assumed to be the same, with sufficient accuracy for practical purposes. In such case, $a_1 = a_2 = a_3 = a_4 = a$, but is not equal to a_n, and (11) becomes:

$$F = 1/(1 + a_n + a_na + a_na^2 + a_na^3 \ldots + a_n..a^{n-1}) - \frac{c}{x}(1 + a_n + a_na + a_na^2 \ldots a_n..a^{n-2}) \tag{12}$$

Further, if the "fresh" solvent contains no solute, $c = 0$, and equation (12) becomes

$$F = 1/(1 + a_n + a_na + a_na^2 + a_na^3 \ldots + a_na^{n-1}) \tag{13}$$

Hawley's original paper shows that if the solvent ratio is the same for all thickeners, then

$$F = 1/(1 + a + a^2 + a^3 + \ldots . a^n) \tag{14}$$

where n is the number of thickeners.

This also follows from equation (13), but generally the unextracted solid contains a different and lower amount of solvent than the solid withdrawn from any extraction vessel.

Equation (14) can be further simplified. Let x_n = the composition of solution in the nth unit. Therefore, per pound of solvent entering the system, the weight extracted is ax_n. But the amount extracted is likewise

$$x(1 + a + a^2 + a^3 + \ldots . a^{n-1}) \tag{14a}$$

or

$$x_n = x(1 + a + a^2 + \ldots . a^{n-1}) \tag{14b}$$

Multiplying equation (14b) by a, and subtracting equation (14a) from the product,

$$(a - 1)x_n = x(a^n - 1) \quad \text{or} \quad x_n = x(a^n - 1)/(a - 1) \tag{14c}$$

By cut and try methods, equation (11) can be used to solve problems where the ratio of solvent drained off to solvent retained is a function of the concentration. Such a method is at best very tedious, and such problems are most easily worked by the method of Ravenscroft (to be published, *Ind. Eng. Chem.*, 1936).

If conditions are such that equations (12) or (13) apply, it is the writer's opinion that these equations offer the simplest and most rapid solution of the problem. The method is illustrated in the following problems:

Problem 1—By extraction with kerosene 2 tons of waxed paper is to be dewaxed per day in a continuous countercurrent extraction apparatus, consisting of a number of cells. It may be assumed that equilibrium is attained in each cell before the underflow and overflow are taken off. The waxed paper contains, by weight, 25 per cent paraffin wax and 75 per cent paper pulp. The extracted paper pulp is put through a dryer to evaporate the kerosene. The pulp, which retains the unextracted wax after evaporation, must not contain over 0.2 per cent

*This should not be confused with the fraction of the total solute, inclusive of that entering as overflow with the "fresh" solvent.

wax. The kerosene used for the extraction contains 0.05 per cent wax, by weight. Experiments show that the pulp will retain 2 lb. of kerosene per pound of pulp as it is transferred from cell to cell. The strong solution from the battery is to contain 5 per cent wax by weight. Calculate the number of cells required.

Solution:

Basis: 100 lb. of wax free pulp.

Wax in on pulp	$= 100 \times 0.25/0.75 =$	33.3 lb.
Wax in with solvent	$= W \times 0.0005 =$	$0.0005\,W$ lb.
Total	$= 33.3 + 0.0005\,W$ lb.	
Wax out in strong solution	$= (W - 2 \times 100)0.05 =$	$0.05\,W - 10$ lb.
Wax out on pulp	$= 100 \times 0.002 =$	0.2 lb.
Total	$= 0.05\,W - 9.8$ lb.	

Therefore,

$$33.3 + 0.0005\,W = 0.05\,W - 9.8$$

and

$$W = (33.3 + 9.8)/(0.05 - 0.0005) = 871 \text{ lb.}$$

Apply equation (12):

$$a_n = \frac{871 - 2 \times 100}{2 \times 100} = 3.355 \qquad c = 871 \times 0.0005 = 0.4355 \qquad x = 0.002 \times 100 = 0.200$$

$$a = \frac{871}{2 \times 100} = 4.355 \qquad \frac{c}{x} = \frac{0.4355}{0.200} = 2.178$$

By the conditions of the problem $F = (0.002 \times 100)/33.3 = 1/166.7$. Therefore the denominator of equation (12) must be equal to, or greater than, 166.7. Set up the several terms of this denominator from the factors calculated above:

Individual terms	Progressive total	$\frac{c}{x} \times$ Progressive total
$1 = 1$	1	.....
$a_n = 3.36$	4.36	.....
$a_n a = 14.6$	18.97	41.3
$a_n a^2 = 63.6$	82.60	179.9
$a_n a^3 = 277.1$	359.70	.....

For three cells $1/F = 82.6 - 41.3 = 41.3 < 166.7$ and for four cells $1/F = 359.7 - 179.9 = 179.8 > 166.7$. Therefore, three cells are not sufficient, and four cells are slightly more than adequate. Four cells are to be used, giving slightly better extraction than is required.

Problem 2—(From Badger and McCabe, "Elements of Chemical Engineering," page 394.) Barium carbonate is to be made by the interaction of sodium carbonate on barium sulphide solution in a countercurrent decantation process. There are fed to the reaction agitators, per 24 hours, 40,000 lb. of BaS dissolved in 60 tons of water, and the necessary amount of Na_2CO_3. Overflow from the second thickener also goes to the agitators. There are five thickeners in series. The overflow from the first thickener is to be a 10 per cent solution of Na_2S. Mud is discharged from the thickeners with a consistency of one part $BaCO_3$ to two parts water by weight. What is the concentration of Na_2S in each thickener, and how much Na_2S will remain in the dried $BaCO_3$ precipitate?

Solution: Since the product of the agitators goes to the first thickener, the agitators may be considered as a part of the first thickener, and the problem worked on the basis of five cells in an extraction battery. A problem of this type has a definite solution, but unless cut and try methods are used it can only be solved by means of six equations involving as many unknown quantities, *i.e.*, the concentrations of Na_2S in each cell and an overall balance. Such a solution at best is very tedious in comparison to a cut and try solution.

Use of 20 tons BaS yields 23.27 tons of $BaCO_3$ and 9.22 tons of Na_2S. The water in the underflow will, therefore, be 46.54 tons H_2O per day.

Since with five thickeners or cells in the battery the extraction will be nearly complete, as a first approximation, the Na_2S not extracted may be neglected, and a water balance made.

First approximation:

Water out with extracted solids	=	46.54 tons
Water out as strong solution $= (9.22 \times 90)/10$	=	82.98 tons
Total water out	=	129.52 tons
Water in with unextracted solids	=	60.00 tons
Water in as fresh solvent (difference)	=	69.52 tons

Equation (13) applies. Here $a_n = 82.98/46.54 = 1.78$ and $a = 69.52/46.54 = 1.49$. The denominator of equation (13) is the sum of $1 + (a_n = 1.78) + (a_n a = 2.65) + (a_n a^2 = 3.95) + (a_n a^3 = 5.89) + (a_n a^4 = 8.78)$ which totals 24.05. Then, $F = 1/24.05 = 0.042$. Na_2S not extracted $= 9.22 \times 0.042 = 0.387$ tons. The composition of solution out in last underflow $= 0.387/46.54 = 0.0083$. This does not check with the assumption that no Na_2S was lost with waste $BaCO_3$. Therefore, make a new assumption, allowing something over 0.378 tons Na_2S in waste. For the second approximation the composition of underflow may be assumed to be 0.01.

Second approximation:

Na_2S balance		
Na_2S in	=	9.220 tons
Na_2S out in waste $= 46.54 \times 0.01$	=	0.465
Na_2S out in strong solution (difference)	=	8.755 tons
Water balance		
Water out in strong solution $= (8.755 \times 90)/10$	=	78.80 tons
Water out with waste $BaCO_3$	=	46.54 tons
Total water out	=	125.34 tons
Water in with unextracted solids	=	60.00 tons
Water in as fresh solvent (difference)	=	65.34 tons

To apply equation (13) $a_n = 78.80/46.54 = 1.69$ and $a = 65.34/46.54 = 1.40$.

The denominator of equation (13) is the sum of $1 + (a_n = 1.69) + (a_n a = 2.37) + (a_n a^2 = 3.32) + (a_n a^3 = 4.65) + (a_n a^4 = 6.51)$ which totals 19.34. Then, $F = 1/19.34 = 0.0517$. Na_2S not extracted $= 9.22 \times 0.0517 = 0.477$ tons. The composition of the last overflow $= 0.476/46.54 = 0.0102$. This is sufficiently close to the second assumption to render unnecessary a third "cut and try" calculation. The Na_2S which remains in the final mud is, therefore $(0.477 \times 100)/9.22 = 5.17$ per cent of that charged. The compositions of solution in each of the several thickeners may now be found by simple material balances, each of which will involve only one unknown.

Case 2: Batch Countercurrent Extraction—Ravenscroft (*loc. cit.*) has shown that the number of units for batch countercurrent extraction, N_B, is related to the number required for continuous countercurrent extraction, N_C, by the equation

$$N_B = (N_C + 1)/2 \qquad (15)$$

These problems are, therefore, calculated just as though continuous countercurrent extraction were to be employed, and equation (15) is then applied.

Industrial Medicine and Toxicology

Speaking before the Columbus, O., meeting of the American Institute of Chemical Engineers, this well known medical director presented the following important conclusions:

(1) Industrial medicine should provide (a) proper selection of employees (Complete pre-employment examinations). (b) Protection of employees by periodic examinations. (c) Treatment of occupational diseases when they occur.

(2) Industrial toxicology reveals the toxicity of chemical compounds by studying the toxicity, mechanism of action, organs affected and symptons to be expected.

(3) No industrial medical program can be properly devised without first obtaining a complete picture of the toxicology.

(4) There is no material, regardless of its toxicity, which cannot be handled with safety, provided the toxicity is understood and proper methods of handling instituted.

MODERN civilization demands that we improve the old methods by which workmen were made ill and died by the score, and that we devise adequate methods of preventing occupational poisonings and diseases. Therefore, it is necessary that chemical engineers and physicians should become more closely associated in order to develop sufficient knowledge concerning these health hazards, and with this knowledge to institute protective measures which will make all plant operations safe.

Industrial medicine is not a new specialty; neither is the recognition of occupational diseases of recent origin. Bernardini Ramazini, during the 17th century, wrote a treatise on the diseases of tradesmen, in which he recognized many diseases of occupational origin. He defined industrial medicine when he said, "We must own that some arts entail no small mischiefs upon the respective artisans, and that the same means by which they support life and maintain their families are oftentimes the cause of grievous distempers which hurry them out of the world." Compare the simple industrial operations of Ramazini's time with the complex operations and toxic substances of today and it is obvious that we are facing a complicated problem that must be worked out by the clinician and the toxicologist, as well as the engineer.

What is industrial medicine and how may it be successfully applied? It is not simply the treatment of occupational diseases and intoxications, but includes that which is more important—medical methods for the prevention of these diseases.

Occupational diseases occur as a result of exposure to toxic substances and lack of proper medical supervision. Some of these diseases are the results of years of exposure and cannot be cured; for example, silicosis, a disease in which clinical symptoms do not appear until there has been extensive lung damage. Unfortunately, this damage is progressive and incurable. There are industrial diseases that are sudden in onset and terminate in death in a few hours; in this class we have chlorine poisoning, which causes an acute respiratory disease. There are acute occupational diseases which appear almost immediately after exposure, run an acute course for a period of 12 to 48 hours, and clear up in a few days. Aniline and nitrobenzol are examples of substances which cause this type of illness by their action upon the red blood cells, forming methemoglobin, which is followed by the destruction of many millions of the cells. These and other examples of industrial intoxications have developed with the progress of industry and have been recognized as the result of bitter human experiences, inestimable suffering and often death.

Industry must realize that the previous methods of trial and error are no longer acceptable, neither are they economical. Further, we must develop accurate knowledge of health hazards before operations are started. Operative procedures must be designed to prevent toxic exposure, and industrial health must have adequate medical protection.

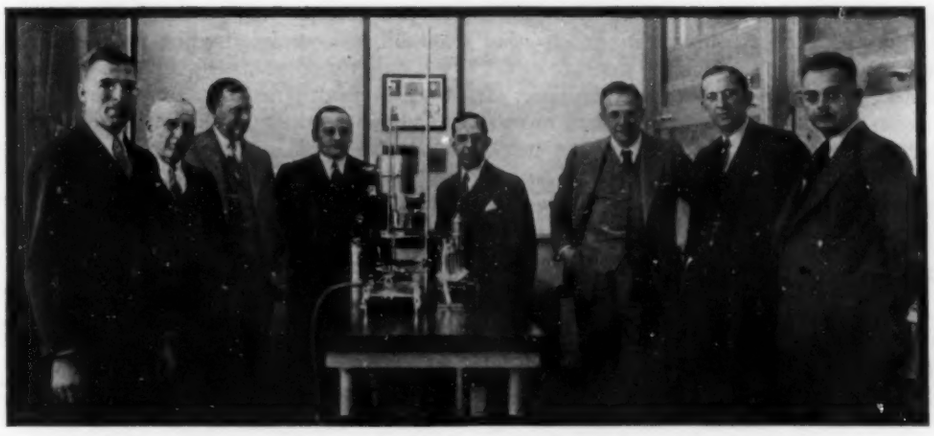
The toxicologist, by proper methods of animal study, can develop the toxicity of a compound and the mechanism of its action. From these facts he can point out both the precautions necessary for safe operation in the plant and the clinical symptoms which indicate the beginning of poisoning. With this information the industrial physician can establish adequate methods of medical supervision, organized on three basic principles; viz, proper selection of all employees, special medical protective examinations, and treatment of occupational diseases.

Pre-employment physical examination is the only means of making the proper selection of employees. The success of this examination is dependent upon several factors. The examiner must have at least a reasonable knowledge of the working conditions of the plant and the physical and mental requirements of the individual

Based on a paper entitled "Industrial Medicine and Industrial Toxicology" presented by the Author on Nov. 13, 1935 before the Columbus, O. meeting of the American Institute of Chemical Engineers.

By G. H. GEHRMANN, M.D., F.A.C.P.
Medical Director, E. I. duPont de Nemours & Co., Wilmington, Delaware.

Make for Safer Plant Operation



Du Pont company executives in the Toxicological room of the Haskell Laboratory of Industrial Toxicology.

From left to right: William Deichmann-Grueber, assistant to Dr. W. F. von Oettingen; Ernest B. Benger, assistant chemical director; Dr. A. P. Tanberg, director of the Experimental Station; C. C. Ahlum and E. F. Hitch, of the company's Jackson Laboratory at Deepwater Point, N. J.; Dr. W. F. von Oettingen, director of the Haskell Laboratory; Lammot du Pont, president; and Dr. G. H. Gehrmann, medical director.

jobs. Job requirements have a wide range of variation. For example, the physical effort necessary safely and efficiently to perform duties may range from physical perfection of 100 per cent down to a very low percentage. The worker who is engaged in lifting heavy materials all day must possess more physical ability than one who maintains temperature and pressure regulations in a chemical operation. Furthermore, the worker who possesses the physical strength to perform laborious work all day may not have the mental requirements that would make him an efficient chemical plant operator.

There are many compounds used in industry which are toxic and under certain conditions may cause sudden death; examples of these are HCN and H_2S. The latter in high concentrations kills almost instantly and, further, these high concentrations cause rapid paralysis of the olefactory nerve with a complete loss of the sense of smell. Therefore, it is possible to walk unaware into a high concentration of H_2S, become unconscious, and die before rescue is possible. Concentrations above 500 parts per million are dangerous.

Other compounds are toxic to a lesser degree, act more slowly and produce chronic disease—some in a short time and others after years of exposure. Lead is an example of the former. Lead gives rise to acute symptoms, depending upon the amount of the daily exposure, in a few days or a few weeks. Then, as examples of those compounds which require years to act are certain nitro- and amino-compounds which cause simple tumors and cancers of the urinary bladder after an average exposure of eleven years.

Some compounds have a selective action upon certain organs. Carbon tetrachloride interferes with the function of the heart muscle. This action is more severe when the heart muscle is affected by heart diseases. Therefore, an individual with a normal heart muscle may successfully withstand the effects of this substance, but one with a diseased heart muscle may die with acute cardiac failure.

Mercury compounds are eliminated through the kidneys and cause severe irritation with acute or chronic nephritis. Phosgene, nitrous fumes and other irritant gases cause marked inflammation of the lungs and may aggravate a more active pulmonary tuberculosis. Any chronic lung disease may be aggravated to such a degree as to cause acute illness, permanent disability, or death. Organic disturbances of the central nervous system may be aggravated by such compounds as carbon bisulphide and those of lead. Lead intoxication produces an encephalitis, which is almost impossible to differentiate from the mental disease produced by late syphilis.

These are some of the possibilities which must be considered by an examiner in order that he may protect an applicant, who has an already established disease, from

working with compounds that will aggravate or activate his condition.

In 1911, the first compensation laws were passed in this country. Prior to this time there were, to the best of my knowledge, no physical examinations in industrial plants. The passage of these laws made industry responsible for accidents and physical disabilities, and the physical examination was introduced as a protection against claims for conditions that existed before employment. At that time applicants were refused employment for even minor physical defects. Later, the compensation laws were amended to include occupational diseases as well as injuries. This necessitated a more complete employment examination and developed the periodic examination as a method of detecting the beginning symptoms of occupational diseases. Experience indicated that respiratory diseases were being frequently missed, the errors in diagnosis being reflected in the incidence of activated lung processes occurring after exposure to irritant gases. Kidney damage was, in a like manner, being overlooked, and cardiac and circulatory pathology either missed entirely or the findings not given the proper interpretations.

Purpose of Physical Examination

There then came the realization that physical examinations for industry should be of such a nature as to accomplish two purposes: First, to select applicants and place them in occupations that would not aggravate any existing disease; second, to eliminate the unnecessary exclusion of applicants who, although they presented certain physical defects, were nevertheless able, safely and efficiently to fill properly selected jobs. In order to accomplish these purposes we realized that we must have more accurate diagnosis at the time of employment.

A medical diagnosis is made by combining what the patient tells the doctor with the findings as observed by the doctor. Both factors are extremely significant and probably of equal importance. Patients present themselves to their personal physician to be cured of an illness and naturally tell of all their complaints. On the other hand, applicants for employment present themselves to the examiner with hopes of passing their examinations and, therefore, have an incentive to cover up any existing illness and conceal many pertinent facts concerning their medical history. This places the examiner at a disadvantage, and so in order to detect lung pathology, liver disfunction, nephritis, cardiac diseases, circulatory disturbances and central nervous involvement, he must have at his command all the modern diagnostic equipment for making: urine analyses, blood examinations (including blood chemistry), blood counts, serum examination for syphilis, X-ray films of the chest and, in special cases, electrocardiograms and basal metabolism tests.

Unfortunately, there are too many industries today giving little or no consideration to such an examination and many others making no examination at all. They consider this work unnecessary as long as their insurance carriers give them adequate coverage. Many are unaware of the hazards that exist in their factories, others show no interest until they are forced to become interested, either because of compensation experiences, civil suits, or insurance rates that have increased to such an extent as to be reflected in higher production costs. Too many are satisfied with a superficial examination which costs comparatively little money, does not supply adequate information or protection, gives a false feeling of security and, in truth, is wasted time, money and effort. All too frequently the physicians making these examinations have little or no knowledge of factory conditions, job requirements, and health hazards that exist.

Selection is the first step toward the successful application of industrial medicine and the second is adequate protection. Adequate protection is provided by two means—properly designed operative, protective measures and equipment, and periodic medical examinations. Protective equipment is an engineering problem that should never be planned until the toxicologist has pointed out all the health hazards that may exist, and before he can do this he must make a careful toxicological study, which should be completed while prospective operations are in the experimental stages. By the time they have reached the semi-works, it is usually too late because the equipment for production has been selected.

In the past, many chemical engineers have assumed that because they have been able, or more frequently fortunate enough, to work through the experimental stages of a project without any visible damage to themselves, the compound at hand was non-toxic. This assumption is frequently erroneous since it is possible to have degenerative processes started in certain organs without visible or clinical evidence. For example, degenerative process in the liver may be very extensive before there is any clinical evidence. Therefore, it is a decided advantage, both from the health and economic viewpoints, to know how to start new operations with safety. There are today many operations which should be improved. Some can be made safe with reasonable changes; others will require a complete change of operating equipment.

The question may well be asked, "Why do we need periodic medical examinations if our factories are equipped with operative devices that eliminate exposure to health hazards?" My answer is: First, I have yet to see the mechanical equipment, no matter how perfect, that will continue to remain so, and very often the first knowledge of its faulty function is the appearance of toxic phenomena in the employees. Secondly, there frequently arise new sources of contamination, sometimes from within the operation and sometimes from without. Thirdly, the human flesh is heir to many ills, some developing slowly, others rapidly, many insidiously. There are many chronic ailments that are never suspected until far advanced. Many of these can be detected early and at least improved by removing the individual from any source of possible toxic irritation.

Frequency of Periodic Examination

The frequency of periodic examinations should be determined by the toxicity of the compound involved and the rapidity with which it may enter and attack the human body. Lead, for example, may produce symptoms in a few days or it may take years, depending upon the atmospheric concentrations. Benzol may cause chronic poisoning in a few days and I consider monthly examinations necessary in both lead and benzol operations. Nitro- and amino-compounds are all more or less toxic and workers in these compounds should have an examination at least every three months. Chemical plant

workers who are not exposed to any known hazards should be examined once a year.

Periodic examination should be designed to bring out the physical signs and symptoms to be expected with the exposure to certain substances and need not necessarily include a general physical examination. Beta naphthylamine, alpha naphthylamine and benzidine, for example, cause tumors of the urinary bladder, and in so far as we know, do not affect other organs. Therefore, it is only essential to make a careful search for these tumors. Benzol, by its action upon the blood-forming elements causes a primary anemia which can be detected by certain blood examinations. Thus, the entire field of periodic examinations should be based upon the clinical signs to be expected. Here again the toxicological study of a compound makes it possible to design a type of examination that will reveal to the clinician the evidence of beginning organic changes within the body.

The appearance of clinical evidence of intoxication in a well-controlled operation may mean either a failure of proper function in the equipment or a careless workman who is not following the rules of hygienic control. Faulty equipment is usually reflected in a group of employees; disobedience to rules and regulations in single individuals. In either event, the evidence indicates that employees are being poisoned, and the source of contamination should be corrected. The correction of faulty operative conditions is necessarily an engineering problem. The matter of proper handling of an individual who is showing signs of toxic absorption is entirely medical and in each individual case the physician must decide whether it is safe for the employee to continue in his operation or whether he must be removed from source of further intoxication and given special treatment.

Industrial toxicology offers the means of avoiding frequent repetition of our past experiences of human suffering, acute illness, chronic illness and death. With the aid of the toxicologist and the pathologist, we can eliminate from our industries occupational diseases and toxic processes. We can start all new operations with adequate protective measures and a scientific understanding of the toxic symptoms to expect, based upon our knowledge of the mechanism of their production.

The toxicity of a compound may vary with the conditions under which it is used. Substances which give little or no trouble at ordinary temperatures become extremely toxic at higher temperatures; some substances decompose and give off poisonous products when heated. Carbon tetrachloride brought into contact with hot metal or an open flame is oxidized and phosgene is liberated, which has a destructive action on lung tissue. In order fully to understand the toxicity of a compound, we must know how the material is handled, the temperatures to which it will be subjected, physical changes in the operation, the various conditions under which it will be handled and the possible chemical changes which may occur.

There must be a very careful study of the effect of a compound upon the body organs. What does it do? How does it do it? What organs of the body are affected and what clinical symptoms are to be expected as the result of intoxication? There are certain substances which produce disease mechanically and in themselves are not poisonous. Silica dust is an excellent example of this type of material. Fine silica dust when inhaled eventually becomes imbedded in the lung tissues, setting up an irritation which is followed by the formation of fibrous tissues. The physical characteristics of the lung change. It loses its elasticity and its function is interfered with, depending upon the stage of the disease. This is the disease known as silicosis. Silicosis is chronic, progressive, incurable and often leads to total and permanent disability. When complicated with tuberculosis it is usually fatal.

The subject of toxicology requires the development of an extensive amount of knowledge, otherwise its application to industry is of no practical value.

Haskell Laboratory of Industrial Toxicology, a new medical research laboratory of the du Pont company, which has been erected on the grounds of the company's Experimental Station near Wilmington, Del.

PRESSURE STORAGE
Of Gases and Liquids

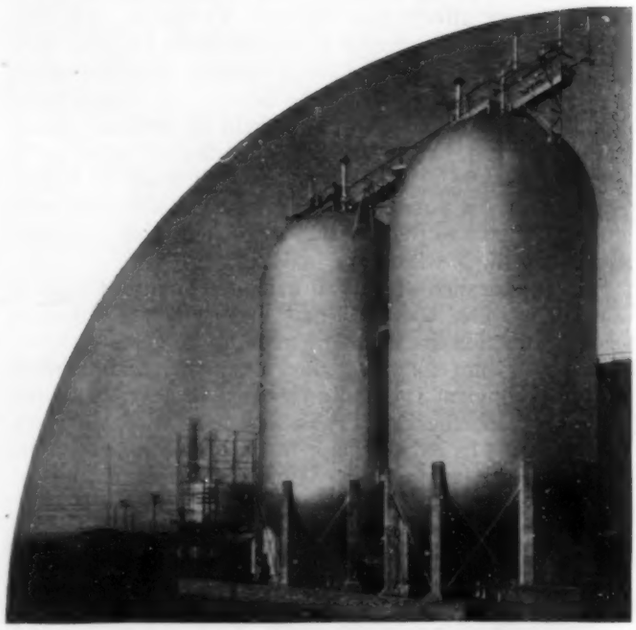
By R. S. McBride
Editorial Representative, Chem. and Met.
Washington, D. C.

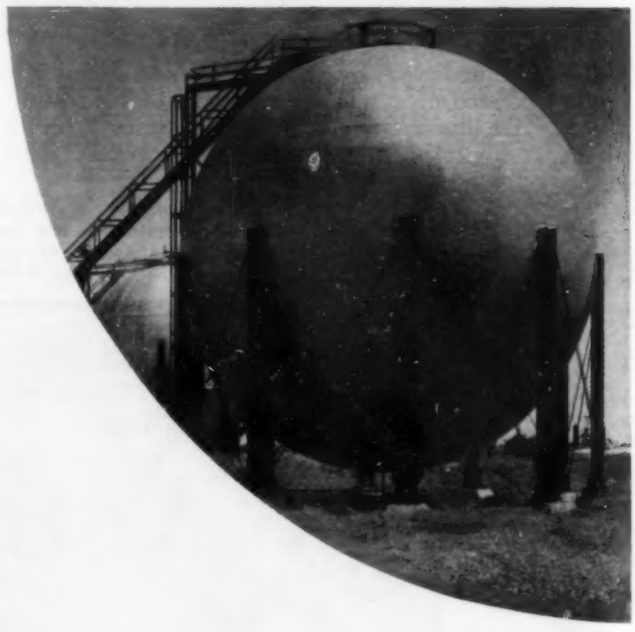
PRESSURE STORAGE has been used principally for manufactured and natural gas by city utility companies. It is far more widely applicable and really deserves more attention from chemical engineers than it has had. Pressure storage has distinct advantages for chemical, as well as, fuel gases. Often its advantages for liquid storage, particularly the storage of liquefied gases, permit large economies either in first cost or in operating expense.

Originally the idea of pressure storage of gases was centered around the thought that a smaller container could be utilized for a given quantity of gas, permitting the placing of the storage at points where limited floor space or limited headroom forbade use of the ordinary type of gasometer. This, moreover, still remains an outstanding consideration for many intra-process chemical operations. In the case of utilities, the small pressure holders could be located in restricted areas, with minimum objection. Oftentimes such holders merely float on the line between one stage of processing and the next, giving a convenient balance wheel on gas produced in one unit and utilized in a succeeding operation. In this respect the pressure unit functions in substantially the same fashion as a gasometer except that the pressure on the gas supply line varies. This characteristic which may be a minor disadvantage is, however, often more than offset by the fact that the storage unit can be placed close to processing equipment, even housed indoors, without decreasing its capacity below desired size.

The major application of pressure storage tanks continues in the field of fuel gases. But the petroleum, natural gasoline, and refinery divisions of the industry are now far more active in new construction of this type than in utility gas companies. A wide variety of equipment finds application. The cylindrical type tanks are probably used more in smaller sizes. The spherical and cylindrical units in 250 M. cu.ft. size are used individually or in batteries. The choice between cylindrical and spherical tanks is largely a matter of costs. The fundamental principles involved in design, construction and use are, of course, substantially the same.

It may be noted that the gas storage units resemble strikingly those used for liquid storage. The most striking difference, which reveals at a glance whether gas or liquid be contained, is the weight and strength of the supporting structure. The dead weight load, of course,





Left above—Welded pressure storage for light naphtha. Liquid capacity, 8,500 bbl. per tank; operating pressure, 35 lb.

Left below—Both welded and riveted construction are used in these 48 ft. refinery-gasoline spheres

Right above—High-pressure rubber-lined acid storage

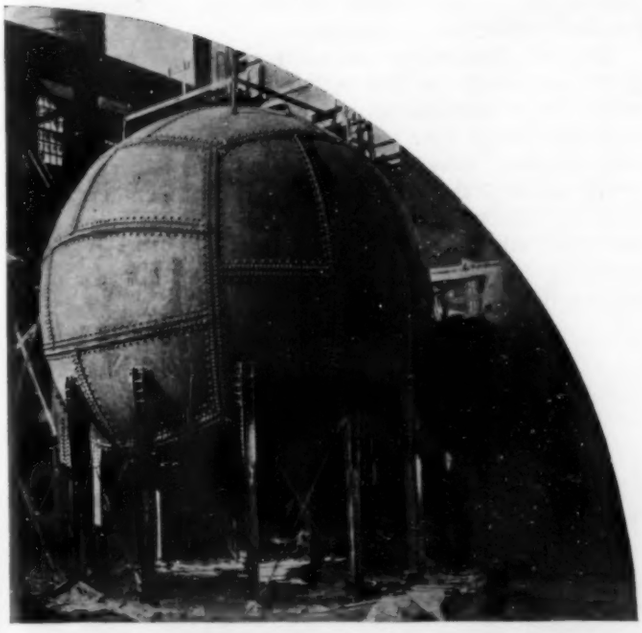
Right below—Spheroid units of 20,000 bbl. each

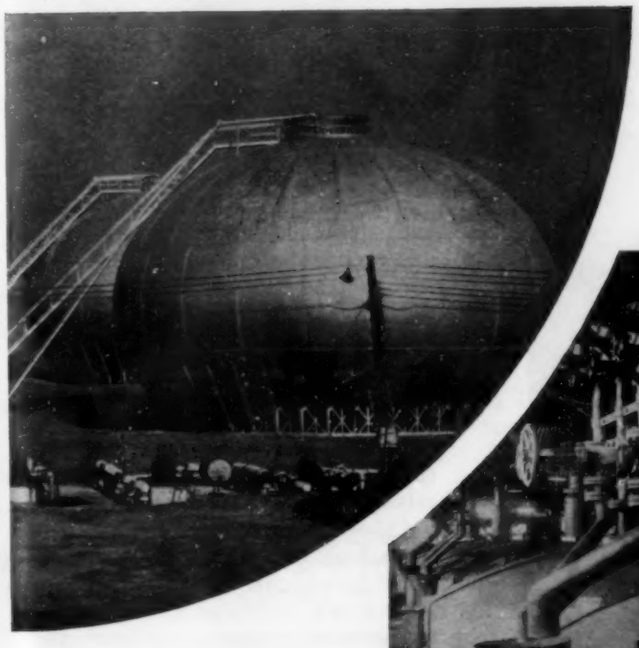
forms substantially the total on these foundations in the case of gas containers; but in the case of liquid pressure storage the contained load of liquid itself often weighs many times as much as the tank, necessitating substantial increase in foundation strength.

Especially for fuel gas storage, pressure tanks are commonly equipped with automatic devices for gas inlet, often with compressor equipment automatically controlled for forcing the gas into storage according to predetermined time schedules or in accordance with prevailing pressures. For public utility supply systems it is often important that the tank be filled from the supply line during periods of light demand from the customers. Automatic timed controls on the pumping equipment may be used or electrical control devices with remote control by an operator. In either case, the objective is to fill the tank to its peak of working pressure in advance of the period of large customer demand. The available supply is thus a maximum at the time of peak need.

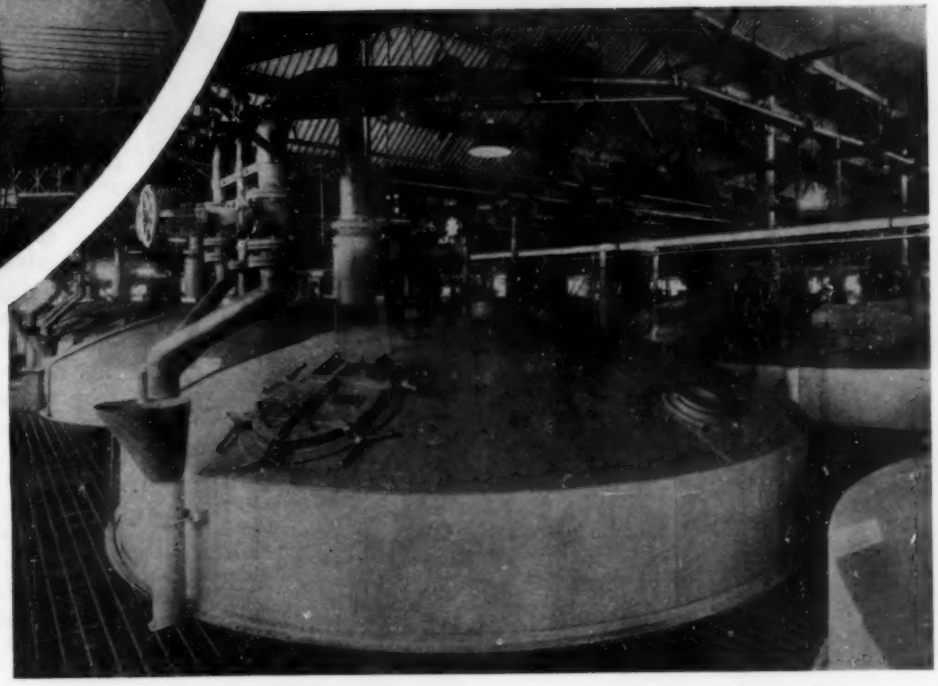
Discharge from pressure containers is also automatically controlled through reducing valves for most fuel gas systems. At times these reducing valves are placed close to the holder discharging directly into distributing systems. In other cases the outlet lines are carried at pressures substantially higher than those in the distributing system and a second step down from the transmission pressure of 5 to 10 lb. is provided near centers of gas consumptions about the town. The same low pressure distributing system, usually operated at 6 or 7 in. of water, can then be maintained uniformly with a minimum of increase in size of the distributing pipe system itself.

The largest single-unit containers found of the pressure type are used in the petroleum industry. Many of these are of the spheroidal type. This design, of course,





Some of the 36 pressure fermenters used to control gas evolved in large distillery



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has the advantage of giving the maximum strength for a given shell thickness. Support of this type of structure is also more economically arranged than for the spherical or cylindrical containers of the same capacity.

Use of pressure equipment is almost essential in the natural gasoline industry. Producers of propane and butane would, of course, find it utterly impractical to handle these byproducts of their industry in atmospheric-pressure units The cost of construction of low-pressure storage would be prohibitive and the difficulty of maintenance extremely great. Welding has been widely used in recent years in the fabrication of pressure vessels.

The accompanying illustrations show both shapes and also illustrate both common types of construction, namely, welding and riveting. For designs in which the pressure does not exceed 100 to 150 lb. per sq.in., welding has been widely used in recent years.

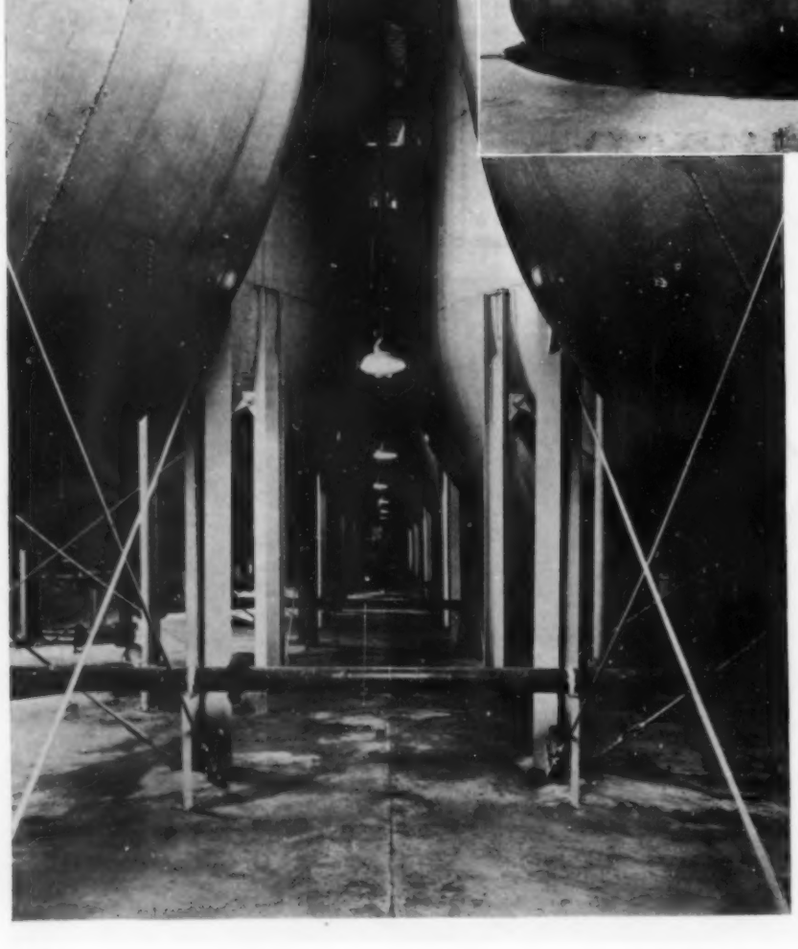
In a wide variety of chemical processes some gas storage is required. To a considerable extent liquid storage under gas pressure is also often of advantage. The use of the pressure tank equipment is, therefore, rapidly extending through process industry.

Economy and size, permitting convenient location and housing, if necessary, are among the principal advantages. But in many cases storage of gas under pressure is essential in order to keep a product, or inter-process gas supply, dry and wholly free from atmospheric contamination. Liquid-sealed holders are, of course, impractical under such circumstances.

The fact that equipment of this sort has no moving parts contributes to the certainty of operation. And where large installations are required there is another great advantage over water-sealed storage, especially in cold weather. Any one who has had the experience of trying to keep the water cups on a large holder from freezing during 20 below zero blizzards will appreciate this latter advantage. And the advantage shows on the operating-cost sheet, too, especially where steam for preventing holder freeze-ups can be made only at high cost.

Right—Latest pressure storage for liquids; 80,000 bbl. capacity

Below—Welded fermenters, part of group of 36, are in effect pressure storage units



The most important advantage of such storage is, however, the fact that gas or liquid stored under gas pressure is ready to use without supplemental pumping or compressing. In the case of highly corrosive liquids elimination of pumps from the transmission lines is of first importance. Hence storage of corrosive chemicals in rubber-lined pressure tankage is receiving increased attention in many establishments.

Other incidental advantages noted in various plants deserve consideration. In one case the use of pressure tankage was indicated merely for the convenience of steam sterilization of the storage units at requisite intervals. Low-pressure tankage did not permit quick high-pressure steam treatment and thus prolonged the idle period between operating cycles. The advantages clearly demonstrate why pressure-type units are receiving, and well deserve, increased attention and more frequent use than in the past.

Petroleum Engineering and Economics Hold Stage at Los Angeles

EDITORIAL STAFF REPORT

More than 3,100 oilmen gathered in Los Angeles for four days (Nov. 11-15) to hear a long program of papers and 53 committee reports presented before simultaneous sessions on production, refining and marketing. Here are the major developments of chemical engineering interest.

SHARING honors in general interest at the recent Los Angeles meeting of the American Petroleum Institute were a new estimate—the first since 1925—of underground oil reserves and probable consumption over the next 25 years and a discussion of new processes for the manufacture of high-octane gasoline for aviation and blending purposes.

No national shortage of petroleum now impends or is likely to occur, according to a report of the executive committee of the board of directors of the Institute. Proved petroleum reserves in the United States are 100 per cent greater now than was estimated 10 years ago. Properly managed, they will adequately meet the needs of at least a quarter century. An almost unlimited secondary reserve exists in the form of coal and oil shales for which processing methods are in commercial use in other countries and await only the operation of economic laws here.

Proved resources in 1925 totaled 5,321 million barrels. In the intervening decade, 8,692 million barrels have actually been produced yet proved reserves at present exceed 12,000 million barrels. Undiscovered reserves are considered greater than ever before because of the rapidly increasing depths reached by drilling.

Interesting predictions of future demand are based on an increase in population from 122,775,000 in 1930 to 146,000,000 in 1960; in passenger cars, from 22,400,000 in 1935 to 31,100,000 in 1960; and in trucks, from 3,600,000 in 1935 to 6,000,000 in 1960. The average motor fuel consumption per vehicle is expected to increase from 690 gal. per year in 1935 to 730 gal. in 1940, partly due to the disproportionate increase in trucks, decreasing thereafter because of lighter cars and changed engine design to 670 gal. in 1960.

Domestic crude oil demand of 719,500,000 bbl. in 1935 with 43.76 per cent converted to motor fuel, is expected to reach a peak of 1,109,800,000 bbl. in 1950, declining thereafter to 1,071,020,000 bbl. in 1960 with 57.88 per cent converted to motor fuel. In 1914, the conversion was only 17 per cent.

Newest means of increasing the yield of motor fuel is by polymerizing or condensing the olefinic gaseous wastes from cracking stills to high-octane liquids. Enough gas of this type, now burned as fuel, and excess natural gas fractions are available, it is reported, to make 110,000,000 bbl. of gasoline per year, or 25 per cent of the 1934 consumption. Such figures are startling but somewhat misleading, because the cost of processing the gas limits its application for the present to premium grades of aviation fuel and blending compounds. One wonders if the present wave of interest in polymerization will sweep the country as did hydrogenation a few years ago. Chemical engineers in petroleum practice have shown that they have many rabbits ready to be taken from the hat, but usually they do not bring them forth until the carrot tops are both green and ample.

Polymerization processes have passed through 25 years of laboratory study. The recent development which calls them into industrial use is the rapidly increasing demand for anti-knock aviation fuel. Motor gasolines made by fractionation and thermal cracking have a natural octane rating of 40 to 65, compared with an ideal of 100. It may be increased to about 87 by the addition of natural gasoline fractions and tetraethyl lead. This was sufficient until airplane motor improvements recently permitted increasing advantage to be gained by going on up to 100 octane.

Higher Octane Fuels

Increased speed, altitude, and flying radius are all possible now in sufficient degree to warrant the extra cost required to produce the higher octane fuels, and this is all that is needed to bring out the rabbits. The first general interest was aroused at the New York meeting of the A.C.S. by Egloff and Ipatieff, followed by one paper at the San Francisco meeting and two at the present Institute meeting. M. B. Cooke and H. R. Swanson of Alco Products, Inc., New York, and C. R. Wagner of the Pure Oil Co., Chicago, described a thermal process for making 78 to 110 octane motor fuel from olefin-bearing gases at a cost of around 5 cents per gallon. P. C. Keith, Jr., and J. T. Ward of the M. W. Kellogg Co., Jersey City, described another thermal process with an estimated cost of 3.53 cents per gallon. Several plants of various types are already in operation and half a dozen more are under construction in various parts of the country. (See New Process Section, November, *Chem. & Met.*)

Road tests of motor fuels were reported by George Granger Brown, professor of chemical engineering at the University of Michigan, in a study of fuel volatility, gasoline mileage, and acceleration in a low-priced passenger automobile.

Diesel engine fuels for automotive service were discussed in a joint paper by William Mendius and W.

Ainslee of Sinclair Refining Co., Chicago, and C. H. Schlesman of Socony-Vacuum Oil Co., New York. They surveyed the volume of diesel fuels available from present crude oil supplies and compared their properties with requirements of present motors. The present tendency of each motor manufacturer to establish individual fuel requirements is likely to increase both manufacturing and distribution costs. The authors recommended cooperation between engine builders and refiners to permit the use of household furnace oils in diesel automobiles and thus use an existing system for distribution. Two grades of such fuel are available and these can probably supply the diesel market satisfactorily.

Better Lubrication and Lubricants

Exploring the little-known field of lubrication fundamentals, G. L. Clark and R. R. Sterrett of the University of Illinois and B. H. Lincoln of Continental Oil Co., Ponca City, Okla., presented X-ray diffraction studies of the orientation of polar molecules on metal surfaces. Accepting the theory that wear occurs because of fields of force between the molecules of adjacent bearing surfaces, they sought to neutralize these forces by causing the metals to absorb polar molecules to form oriented, not merely viscous, films. The strongly polar molecules of chlorinated esters produced adsorbed films of unusual molecular thickness and regularity of arrangement. The addition of methyldichlorostearate to petroleum lubricants in one per cent concentration was found particularly effective in reducing the wear of rubbing surfaces.

In a supplementary paper, L. L. Davis, B. H. Lincoln and B. E. Sibley, also of Continental Oil Co., discussed lubricant improvements demanded by the increased speeds, loads and temperatures of recent automotive engines. The selection of chemical admixtures to produce the desired combination of properties was presented in detail, attested by both laboratory and road tests. Small percentages of chemically stable highly-polar compounds such as the ester of a chlorinated aliphatic acid and a monohydric alcohol such as that already mentioned were advocated. The complexity of the requirements demand chemical engineering control of a high order. Warning was sounded against a flood of "dopes" being sold with ridiculous claims of merit which may be worthless or even harmful.

Chassis and wheel-bearing greases and other automotive lubricants were described by Ralph R. Matthews, Battenfeld Grease & Oil Corp., Kansas City. He said over 200,000,000 lb. of such greases were manufactured in 1934, a ratio of 1.56 lb. per 100 gal. of gasoline used by automobiles.

Metallurgy and Corrosion

Several informative papers were presented in a general discussion of the properties of iron and steel. H. W. Graham and J. H. Flaherty of Jones & Laughlin Steel Corp., Pittsburgh, described methods of making iron and steel and their resultant characteristics. E. S. Davenport of United States Steel Corp., Kearny, N. J., described alloy steels; James Aston of A. M. Byers Co., Pittsburgh, wrought iron.

The importance of high compression yield strength in establishing greater economical depths for setting oil well casing was discussed by T. McLean Jasper of A. O. Smith Corp., Milwaukee. Yield strengths of 60,000, 70,000 and 80,000 lb. per sq.in. may permit casing strings to be set into the ground to depths of 7,880, 9,200 and 10,570 ft., respectively.

Efforts to develop standard methods of evaluating wire rope service were outlined by K. N. Saatjian of the Texas Co., Los Angeles, and V. V. Mason of Standard Oil Co. of California, La Habra, Calif., who presented a formula for determining the work done in terms of ton miles and recommended a basis for retiring lines from service.

F. N. Speller of National Tube Co., Pittsburgh, described a case of corrosion fatigue in drill pipe used in Texas. He recommended chemical control of colloidal drilling muds, reduction of free oxygen with sodium sulphite, and protection of the metal against scoring.

Flow of Fluids—The properties of oil and gas in a flowing well undergo such large changes during the flowing process that hydraulic flow equations are inapplicable. The energy changes may, however, be determined from *P-V-T* data if the thermodynamic properties of the fluids are known. B. H. Sage and W. N. Lacey of the California Institute of Technology determined such properties for samples from a particular well and analyzed the energy relations involved in its natural flow.

Studies of the flow of drilling mud through two kinds of drill-pipe joints were reported by R. A. March and W. E. Gilbert of Shell Oil Co., Los Angeles. Pumping economies were found possible by changing the design to reduce friction losses.

Pumping—Bruce H. Robinson of General Petroleum Corp., Los Angeles, discussed the economics of oil well pumping with reference to both equipment and energy sources. C. J. Coberly of Kobe, Inc., Huntington Park, Calif., described a hydraulic well pump which uses a reciprocating engine driven pump at the bottom of a well, driven by hydraulic (oil) pressure supplied from a surface pump.

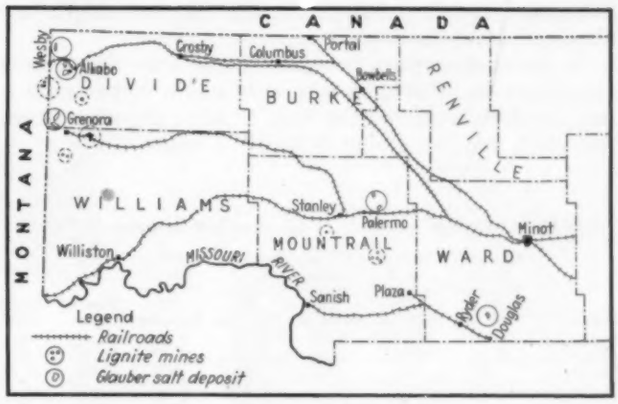
Power Costs Compared

Power—Electric power generated by a diesel plant and two types of steam turbine plants for a large fully electrified Californian refinery was compared with purchased power costs by Roy B. Bryant and Marion E. Dice, General Petroleum Corp. of California, Los Angeles. They found purchased power more economical at present due to a low average demand compared with peaks. With improving plant load factor, a steam-turbine generating plant will permit savings ahead of diesel units. A jointly-owned steam plant supplied with waste or noncommercial grades of fuel from the refinery, operated by a utility and feeding excess power to its system, was suggested as a means to reduce power costs if rates are not sufficiently attractive after the Colorado River development is completed.

Colloidal Drilling Muds—Laboratory tests of rotary drilling muds to evaluate their properties in actual service have been much improved since such muds have been treated as colloidal plastics. (*Chem. & Met. Eng.*, 38, 632-5, Nov., 1931.) A modified MacMichael shearing viscometer was described by P. H. Jones and E. C. Babson of Union Oil Co., of Wilmington, Calif., and its results found poorly indicative of certain service characteristics.

Glauber Salt in North Dakota

An extensive field survey has been carried out the last year under the supervision of the University of North Dakota, as an employment project of the FERA, to investigate the sodium sulphate deposits of the state. The results of this survey, which are not entirely without promise, are briefly summarized here.



By IRVIN LAVINE, HERMAN FEINSTEIN and EARL SKENE

Professor of Chemical Engineering, Chemist, and Field Engineer, respectively
University of North Dakota, Grand Forks, N. D.

FROM the resemblance between the geology of North Dakota and that of states further west, Daniel E. Willard, in his book, "The Story of the Prairies," deduced that dried lake bottoms containing valuable mineral salts might be present in the western part of the state. In 1929 a hard, solid bottom of glauber salt, strong enough to support one's weight, was found a few inches under the surface of a lake 6½ miles from Grenora.

The North Dakota deposits prospected during this survey are found in the northwestern part of the state. They may be grouped as follows: (1) The Grenora group, two large deposits four to six miles northwest of Grenora. (2) The Alkabo group, three deposits west of Alkabo. (3) The Stanley group, two deposits northwest of Stanley.

The deposits are all lake bottoms with no outlet, usually in the lowest depression of a large area, and receiving the drainage from a considerable area. They are white at most temperatures, but above 92 deg. F. the surface may liquefy for a few inches. The deposits are dotted with innumerable springs of concentrated brines. It is not known whether the brines originate from fresh water springs that become saturated in passing through the heavy bed of sodium sulphate, or whether they have received their charge at deeper levels and are bringing the minerals to the surface.

Hundreds of dried lakes were inspected during the survey, mostly mud flats with a thin layer of alkali, too small to be of importance. By checking with township maps a thorough survey was made of each county inspected. Promising deposits were given preliminary inspection by several men with specially designed cylindrical hand augers, with cutting edges at the base of the cylinder, made locally to fit this peculiar type of work. The permanent bed of the deposits was usually so hard that chisel bits had to be used to break the way for the augers. These test holes gave definite preliminary information as to the quality of the mineral and depth of the deposit.

If the test holes established the presence of glauber salt in considerable quantity, the surveyors completed the work of mapping the deposit and locating the places for testing. A plot of the deposit would then be prepared, and marked off in squares of 200 ft. each. The corner of each square was numbered and a crew of workers was put to work to obtain samples and note the depth of the deposit. The augers described were used and extension pipes were added as increasing depth of the hole required. Samples were taken from the auger at successive levels, quartered, and placed in numbered paper sacks which were tied securely and allowed to dry. As the mineral on the outside dried, a core of damp, fully hydrated glauber salt was obtained.

For sampling of springs an ordinary cistern pump was used, equipped with a rubber hose which was dropped into the spring orifice. The solution in the spring was pumped out before a sample was taken for analysis. This probably eliminated surface brines from contaminating the test waters of the spring, but it did

Table I—Glauber Salt Deposits in North Dakota

Name of Deposit	Location	Acres	Maximum Depth of Permanent Bed, Ft.	Average Depth of Bed In.	Total Calculated Quantity Tons	Distance to R. R. Miles	Distance to Lignite Miles
Grenora No. 1	N. W. of Grenora, Divide Co. T. 160N, R. 103 W, Sec. 15, 16, 20	500	30	30.6	1,750,000	7	12
Grenora No. 2	N. W. of Grenora, T. 160N, R. 103W, Sec. 23, 29, 32, 33	500	80	144	11,000,000	5½	12
Miller Lake	S. W. of Alkabo, Divide Co. T. 162N, R. 102W, Sec. 5, 6, 17, 18	550	50	84.8	5,000,000	2	8
Stanley No. 1	N. E. of Stanley, Mountrail Co. T. 157N, R. 89W, Sec. 21, 22, 28, 28	250	10	68.3	1,000,000	7	15
Stanley No. 2	E. of Stanley, T. 156N, R. 89W, Sec. 4, 5, 8, 9	200	5	30	600,000	2½	15
Westby Lake	N. W. of Alkabo, Elkhorn T., R. 102W, Sec. 11, 13, 23	275	20	120	3,000,000	5	10
North Lake	S. W. of Alkabo, Westby T. R. 102W, Sec. 8, 17	200	80	40	1,000,000	1½	8
Rice Lake	Ward Co. Sec. 26, 27, 34, 35, T. 152N, R. 85W	Not Investigated					

not assure sampling before considerable salt might have dissolved from the deposit.

In the northwestern counties of the state the deposits vary from small sloughs with only a thin incrustation of salts on the surface of the mud to large deposits several feet thick and containing millions of tons. Some of the deposits have not been thoroughly examined because of the short time allotted to field work. In many cases they were too small to warrant detailed examination. Certain data on these deposits are compiled in Table I. The information included in the tabulation covers the name of the deposit, its location, size of the deposit in acres, maximum depth of the permanent bed, average depth of the bed, the estimate of the number of tons of glauber salt in the deposit, distance to the nearest railroad system and the distance lignite would have to be transported.

Table II—Chemical Analyses of Glauber Salt Samples in Per Cent

Deposit	Grenora No. 1 Average 61 Samples	Grenora No. 2 Average 128 Samples	Miller Lake Average 83 Samples	Stanley No. 1 Average 45 Samples	Stanley No. 2 Average 56 Samples	Westby Lake	North Lake
$NaCl$....	1.73	1.30	0.90	0.55	0.45	0.92	0.57
Al_2O_3....	0.32	0.33	0.15	0.37	0.22	0.97	0.16
Fe_2O_3....	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Na_2CO_3..	Trace	Trace	0.06	7.21	3.25	Trace	0.16
$NaHCO_3$	0.82	1.00	0.61	4.00	3.26	0.51	0.44
$CaSO_4$...	1.58	1.63	1.26	0.57	0.63	1.90	0.40
$MgSO_4$...	1. 1	2.06	2.92	1.30	1.16	0.71	4.10
Na_2SO_4..	94.84	94.28	94.06	86.00	91.02	93.74	94.65

The samples taken were sent to the chemical laboratory at the School of Mines, University of North Dakota. They were weighed, dried below 32 deg. C. and then quartered to give a representative 6-gram sample for analysis. Determinations included insoluble matter, chloride, iron and alumina, calcium, magnesium, carbonate and bicarbonate, and sulphates, as shown in Table II.

The FERA of North Dakota directed that an economic study be made of these deposits to determine their commercial values; a report of this study will be available soon. Several companies have sent representatives to inspect the deposits and are investigating the possibilities for leases. In providing funds for this work FERA has made an important contribution, not only by giving employment to a large number of persons, but also by advancing the development of this resource and supplying pertinent data to interested individuals or companies.

Protective Coatings for Wood in Sodium Sulphate

By KENNETH A. KOBE and FRANK A. MOREY

Department of Chemical Engineering
University of Washington
Seattle, Wash.

THE natural sodium sulphate industry can carry out many of its unit operations in wooden tanks. Deterioration is more or less rapid depending upon the temperature of the solution. The use of a protective coating on the surface is dependent upon the extended life given the tank. A series of tests (Hauser and Bahlman, *Chem. Met. Eng.*, vol. 36, p. 567-8, 1929) on different types of wood in hot and cold solutions of the common chemicals showed that cypress, yellow pine and douglas fir were most suitable. The protective action of asphaltic and coal-tar base paints was also examined, and it was found that while the protective material was quite resistant to chemical action it was difficult to apply in an impervious condition.

The tests described in this work were made to find a protective coating or lining among the various types now available which may be applied to a wood surface. Douglas fir was chosen as the wood as it is the cheapest resistant wood available in the Pacific Northwest. The most severe operating condition is a boiling saturated solution (102 deg. C.) which was chosen as the test condition.

Samples Tested

Letters were sent to all manufacturers of non-metallic materials listed in the Directory of Materials (*Chem. & Met.* 1934-35 Directory of Materials for the Construction of Chemical Engineering Equipment, vol. 41, No. 10 1934) and to all others advertising resistant paints and coatings. Test conditions were described and many manufacturers replied that their material would not withstand the high temperature; all others submitted samples for test. The test panels were of well-seasoned douglas fir, 8x15x¾ in. in size. The panels were coated on all sides with the test material. The asphalt samples were melted and applied hot, while the cements or plasters were merely spread on the surface to a uniform thickness and allowed to harden, and the paint samples were brushed on, each panel being given three coats. The test panel was then immersed so that about two-thirds of the surface was in the boiling saturated sodium sulphate solution. The test panels were removed after failure of the surface, maximum time of test being 24 days. Samples of plastics were immersed without being attached to wooden panels.

Results

1. All cement samples failed completely in from one to four days by cracking and flaking from the panel.
2. Asphalt and rubber base paints were not impervious, the film softening and blistering after a short time.
3. Laminated synthetic resin sheets satisfactorily withstood the 24-day test and could be used for tank construction or lining, however, they are more expensive than an applied liquid coating.
4. A Bakelite-base varnish withstood the test over the 24-day period. It apparently remained impervious to the hot solution and the only visible change was a darkened color.

It is believed that these results are equally applicable to other hot, concentrated salt solutions that are encountered in the chemical industries.

Chemical Engineer's BOOKSHELF

Economic Trends

THE FORMATION OF CAPITAL. By *Harold G. Moulton.* Published by The Brookings Institution, Washington, D. C., 1935. 207 pages. Price, $2.50.

INCOME AND ECONOMIC PROGRESS. By *Harold G. Moulton.* Published by The Brookings Institution, Washington, D. C., 1935. 191 pages. Price, $2.00.

Reviewed by *R. S. McBride*

THESE are Vols. 3 and 4 in The Brookings Institution series of which the two earlier numbers have previously been reviewed in *Chem. & Met.* (America's Capacity to Produce, *Chem. & Met.*, Sept., 1934, p. 484; America's Capacity to Consume, *Chem. & Met.*, Dec., 1934, p. 654).

These two new volumes differ widely in interest for the chemical engineer and industrial executive. Volume 3, on "The Formation of Capital," is essentially a book for economists, bankers, and those concerned with purely fiscal questions. Within that field it is a very readable, interesting and authoritative work. But it lacks that intriguing applicability to process industry which the fourth number of the series will evidence even to the casual user.

This final volume, "Income and Economic Progress," presents a fundamental consideration of the factors which determine the well-being of industry and the population served by it. The interpretation is simple but thorough, readable, and convincing. The only danger in perusing the pages of this book is that one will find so much of the statement thoroughly believable as to give the impression that the volume contains nothing new.

Most gratifying to the reviewer is the fact that this book is the first of the series which gives strong emphasis on the dynamic characteristics of industrial relations. In that respect it is much more satisfying to the chemical engineer, who is not normally concerned with history, but rather with trends and progress, thinking primarily of the problems of tomorrow and not worrying about the disappointments of yesterday.

The fundamental finding of the book offers no comfort to New Dealers, nor to the peddlers of panaceas. It concludes that neither hard work nor profits are out-dated. It offers as the only permanent remedy to economic disorder a sincere effort on the part of all industry to lower the price of goods to the ultimate consumer in terms of man-hours or in terms of the commodity dollar. Only on that basis, does it suggest that there is any permanent prosperity.

All concerned with the long-time planning of any industry can profit by a careful study of this fourth volume. It will not be altogether satisfying, because it is not quite optimistic enough fully to reflect the trends in process industry. But for industry as a whole it is a fair and convincing picture. Incidentally, it will please chemical industry executives, because it advocates those fundamental policies of management which have had outstanding exponents within the chemical field.

Reflecting 20 Years' Growth

THE HANDBOOK OF CHEMISTRY AND PHYSICS, 20th Edition. *Chas. D. Hodgman,* Editor-in-Chief. Published by Chemical Rubber Publishing Co., Cleveland, Ohio. 1,966 pages. Price, $6.

Reviewed by *George E. Walker*

TO MANY the slim 1914 edition of this handbook represented the first available condensed but comprehensive coordination of data facilitating practical application of the closely related sciences, chemistry and physics. Progressively through twenty expanding editions the publishers have acknowledged helpful suggestions from those in every field who thus contributed to its coverage and increasing usefulness. Consequently the growth has been of highly evolutionary character, consistently reflecting the requirements of the rapidly maturing chemical industry in this country.

Comprising nearly two thousand pages including three hundred of entirely new composition, with revision and rewriting of many pages this edition brings added data into available range. To this reviewer the enlarged scope and change in form of presentation of the section on Physical Constants of Organic Compounds are noteworthy improvements. Replacement of two page tables by uniform paragraphic treatment of compounds with cross-index by number to alphabetically tabulated empirical formulæ considerably simplifies all prior tabulation. The importance of improvement in accepted nomenclature for organics requires no comment, and the inclusion, in slightly abridged form, of the rules of the International Union by Dr. A. M. Patterson, the United States member of the committee on Organic Nomenclature, together with a key to pronunciation as approved by the A.C.S. committee, increase the usefulness of this edition.

Chemical Concrete

THE CHEMISTRY OF CEMENT AND CONCRETE. By *F. M. Lea* and *C. H. Desch.* Longmans, Green & Co., New York, and Edward Arnold & Co., London. 441 pages. Price, $9.50.

Reviewed by *John L. Miner*

THIS is an excellent book. It is recommended to both cement chemists and engineers. It is indispensable as a reference book.

While the title of the book describes its subject matter, the following partial list of chapter headings gives a better picture of some of its contents: Cement Components and Their Phase Relations; Cementing Qualities of the Cement Compounds; The Constitution of Portland Cement; and the Hydration of Portland Cement. Separate chapters are devoted to the raw materials and processes of manufacture of each of the following: portland cement, pozzolanic cements, blast furnace slag cements, aluminous cements, and some special cements. Four chapters at the end of the book relate to the chemistry of concrete and especially to its resistance to various corrosive conditions.

The book is exceptionally well written. Such difficult subjects as the phase rule are presented in such a manner that any engineer or chemist can read the text and understand what it is all about.

In general the authors have very ably selected their references. They appear to know not only what men are doing the best work but also what of their work to select for inclusion in this book. There are of course some inconsistencies and naturally a few erroneous statements and conclusions.

The authors have been generous in their acknowledgment of the work of others. A list of the references mentioned in this book would furnish a very excellent bibliography on the manufacture and use of cement.

The book contains many new data. It also brings together for the first time in useful order a great deal of information more or less known to cement technicians

but heretofore unassembled. For example, in Chapter XX under the title, Resistance of Concretes to Various Organic and Inorganic Agents, data have been collected from English, German, French and American sources as to the resistance of concrete made with portland, aluminous, portland blast furnace, and pozzolanic cements to the corrosive action of mineral oils, organic acids, such as lactic, butyric, acetic, oleic, etc., vegetable and animal oils and fats, and a discussion of the action of sugar solutions, sewage, gases and various inorganic compounds and other materials.

The authors are well qualified to write a book on this subject. In 1911, Mr. Desch, who is associated with the National Physical Laboratory at Teddington (England), published a book on "The Chemistry and Testing of Cement" that has been a recognized reference book for many years.

Mr. Lea has been engaged in studying the constitution of cement at the Building Research Laboratory, Garston near Watford (England). He has presented several very excellent papers. He spent a year with Dr. Bates at the National Bureau of Standards (Washington).

CAST METALS HANDBOOK, 1935 Edition. American Foundrymen's Association, Chicago, Ill. 424 pages.

THE NEW edition of the handbook covers recommendations to designers of castings and to buyers of castings, general information on cast iron, malleable cast iron, cast steel and non-ferrous casting alloys. The chemical engineering interest lies in the treatment of the physical properties; corrosion, heat and abrasion resistance; uses; and limitations in application of these construction materials.

MOLYBDENUM STEELS, THEIR MANUFACTURE AND APPLICATION. By J. L. F. Vogel and W. F. Rowden. High Speed Steel Alloys Ltd., Widnes, England. 103 pages. Price, 5 shillings.

MUCH OF this book deals with the applications of molybdenum to steel making. However, those sections dealing with the influence of molybdenum on the corrosion and heat resistance of low-carbon and other steels are of interest to chemical engineers. Steels for low temperature service are also treated.

British Chemical Research

REPORT OF THE CHEMISTRY RESEARCH BOARD FOR THE PERIOD ENDED 31ST DECEMBER, 1934. With Historical Introduction and Report by the Director of Chemical Research. Available in the United States from the British Library of Information, French Buildings, 5 East 45th St., New York City. Price, 1 shilling 6 pence.

THIS is an excellent historical resume, as well as a current report of the scientific director, of the projects on which British government investigators are engaged in several fields: Corrosion of metals; high pressure research; tar research; chemotherapy; synthetic resins; water pollution; microbiology; road tar.

TECHNICAL ASSOCIATION PAPERS. Series XVIII, No. 1, 1935. Official publication of the Technical Association of the Pulp and Paper Industry, New York, N. Y. 590 pages plus advertising. Price, $6.

IN ADDITION to the proceedings of the annual meeting the volume includes reports of the various committees and all of the papers that were presented at both the spring and fall meetings of the Association. The large number of papers cover a wide variety of subjects of interest to the engineers in the pulp and paper industry in this country.

PSYCHROMETRIC CHARTS FOR HIGH AND LOW PRESSURES. By Donald B. Brooks. National Bureau of Standards, Miscellaneous Publication M. 146. 1935. 8 pages.

THE AUTHOR presents four nomographic charts for determining humidity from psychrometric observations at pressures ranging from $\frac{1}{8}$ to 10 atm. The charts are based on the Ferrel psychrometric formula and are believed to be nearly as reliable at 10 atm. as at 1. Four charts in all are given in both high and low range and for both Fahrenheit, and Centigrade readings. The charts are intended to supplement the earlier ones published in the Bureau's Miscellaneous Publication 143, for pressures near 1 atm.

MANUAL FOR ENGINEERS. Compiled by members of College of Engineering, University of Tennessee. Sold by the University's Cooperative Book Store, Knoxville, Tenn. 139 pages. Price, 75 cents.

THIS handy little vest-pocket-sized book contains an assortment of the most useful tables taken from mechanical, hydraulic, civil and electrical engineering. The following is typical of the contents: mathematical tables, equivalents, weights and measures, steam pressures and steam formulas, elements of sections, pipe and weir tables, hydraulic power tables, fan and steam flow tables, steam tables, shaft and belting tables, wire and wiring tables, earthenwork tables, first aid, etc. Unfortunately, in the review copy, at least, much of the printing is so poor that tabulations are to be read only with difficulty, if at all.

LILLY RESEARCH LABORATORIES. Dedication. Limited edition, privately printed, Indianapolis, 1935. 128 pages plus XII.

THIS handsome volume records the addresses and other activities made and taking place at Eli Lilly & Co.'s dedication of its new research laboratories in October, 1934. Addresses and discussions by internationally known figures in chemistry, biology and medicine are rounded off by a detailed verbal and pictorial description of the company's new research facilities.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash, or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

The Rubber Industry, 1935, by P. W. Barker. Leather and Rubber Division, Bureau of Foreign and Domestic Commerce; mimeographed. A bibliography.

Leather World Production and International Trade, by J. G. Schnitzer. Bureau of Foreign and Domestic Commerce Trade Promotion Series 157; 20 cents.

Trading Under the Laws of Argentina, by Joaquin Servera. Bureau of Foreign and Domestic Commerce Trade Promotion Series 160; 15 cents.

Chemical and Physical Properties of Haddock-Liver Oil and Its Vitamin Content, by S. R. Pottinger and others. Bureau of Fisheries Investigational Report No. 27; 5 cents.

Foreign Commerce and Navigation of the United States, 1934. Vol. I. Bureau of Foreign and Domestic Commerce; cloth $1.75, 852 pages. Gives import statistics only. Export statistics to be issued shortly as Volume II.

The Balance of International Payments of the United States in 1934, by Amos E. Taylor. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 826; 10 cents.

Rules, Policy, and Acts, Federal Trade Commission, July 1, 1935; 10 cents.

Industrial Health and Safety Series. A series of pamphlets issued by the Division of Labor Standards, U. S. Department of Labor, as follows: No. 1, Industrial Skin Diseases; No. 2, Anthraco-Silicosis; No. 3, Arsenic Poisoning; No. 4, Carbon Monoxide Poisoning; No. 5, Chromium Poisoning; No. 6, Mercury Poisoning; No. 7, Lead Poisoning; No. 8, Benzol Poisoning; No. 9, Silicosis; 5 cents each.

Digest of Principal State Labor Legislation, Enacted in 1935 as reported to September 15. U. S. Department of Labor, Division of Labor Standards; 10 cents.

Discussion of Labor Laws and Their Administration. Labor Department, Division

of Labor Standards Bulletin No. 1; 10 cents.

Flaxseed Production in the North Cen. States, by A. C. Dillman and T. E. Stoa. Department of Agriculture Farmers' Bulletin No. 1747; 5 cents. Primarily for farmers.

Safflower, a Possible New Oil-Seed Crop for the Northern Great Plains and the Far Western States, by Frank Rabak. Department of Agriculture, Circular 366; 5 cents.

A Device for Separating Different Lengths of Fibers From Seed Cotton, by Homer C. McNamara and Robert T. Stutts. Department of Agriculture Circular 360; 5 cents.

The Desert Milkweed (Asclepias Subulata) as a Possible Source of Rubber, by R. E. Beckett and R. S. Stitt. Department of Agriculture Technical Bulletin 472; 5 cents.

Wood Handbook. Department of Agriculture, Forest Products Laboratory, unnumbered book; 25 cents. Basic information on wood as a material of construction with data for its use in design and specifications.

Converting Factors and Tables of Equivalents Used in Forestry. Department of Agriculture Miscellaneous Publication 225; 15 cents.

Manual on Preservative Treatment of Wood by Pressure, by J. D. MacLean. Department of Agriculture Miscellaneous Publication 224; 15 cents.

Spray-Residue Removal From Apples and Other Fruits, by M. H. Haller and others. Department of Agriculture Farmers' Bulletin 1752; 5 cents.

Dried Fruit Fumigation, by Perez Simmons and others. Bureau of Entomology and Plant Quarantine Circular E-353; mimeographed.

Report on the Agricultural Experiment Stations 1934, by J. T. Jardine and W. H. Beal. Department of Agriculture unnumbered document; 10 cents.

Engineering Field Tables. Department of Agriculture unnumbered documents, Second Edition, 1935; 75 cents (cloth), 118 pages. A very convenient set of tables regarding surveying, trigonometric functions, earth work, road, culvert, concrete and timber engineering field studies.

Statistical Appendix to Minerals Yearbook, 1934. Bureau of Mines; $1.00, 434 pages. Gives detailed statistics on those commodities not fully covered in the 1934 Yearbook.

Reduction of Evaporation Losses From Gasoline Bulk-Storage Stations, by Ludwig Schmidt and C. J. Wilhelm. Bureau of Mines Technical Paper 565; 5 cents.

Microscopic and Petrographic Studies of Certain American Coals, by Reinhardt Thiessen and G. C. Sprunk. Bureau of Mines Technical Paper 564; 10 cents.

Procedure for Establishing a List of Permissible Self-Contained Oxygen Breathing Apparatus. Bureau of Mines Schedule 13B. Fees, character of tests, and conditions under which mine rescue breathing apparatus will be tested, approved August 12, 1935.

A Microcolorimetric Method for the Determination of Benzene, by H. H. Schrenk and others. Bureau of Mines Report of Investigations 3287; mimeographed.

Benzene in Natural Gas, by H. H. Schrenk and others. Bureau of Mines Report of Investigations 3293; mimeographed.

Production of Explosives in the United States During the Calendar Year 1934, by W. W. Adams and V. E. Erwin. Bureau of Mines Report of Investigations 3285; mimeographed.

The Microprojector for Determining Particle-Size Distribution and Number Concentration of Atmospheric Dust, by Carlton E. Brown and William P. Yant. Bureau of Mines Report of Investigations 3289; mimeographed.

Induction Prospecting for Shallow Ore Deposits and Small Metallic Objects, by J. W. Joyce. Bureau of Mines Information Circular 6854; mimeographed.

Review of Literature on Effects of Breathing Dusts With Special Reference to Silicosis, Part III-A, Chapter 5, *Economic and Legal Aspects of Dust Disease in Industry* (Sections 1 and 2), by D. Harrington and Sara J. Davenport. Bureau of Mines Information Circular 6857; mimeographed.

Procedure for Testing Explosives for Acceptability for Use in Forest Service Work. Bureau of Mines Information Circular 6841; mimeographed.

Mining and Milling Tungsten Ores, by Wm. O. Vanderburg. Bureau of Mines Information Circular 6852; mimeographed.

Petroleum Refineries, Including Cracking Plants, in the United States, January 1, 1935, by G. R. Hopkins and E. W. Cochrane. Bureau of Mines Information Circular 6850; mimeographed.

"Base" of a Crude Oil, by E. C. Lane and E. L. Garton. Bureau of Mines Report of Investigations 3279; mimeographed.

Flame Safety Lamps Requirements for Permissibility, Tests Made, and Fees Charged. Bureau of Mines Schedule 7C; mimeographed.

Readers' Views and Comments

No Electrolytic Action In All-Welded Steel Evaporator

To the Editor of Chem. & Met.:

Sir—A letter entitled "All Welded Steel Evaporators" appeared in your September issue. In it the writer referred to the destructive effect of the electrolytic action of sodium chloride brine, between the copper tubes and the steel evaporator. He refers to the type of salt evaporating pan recently constructed for the Diamond Crystal Salt Co.

As the designers and engineers for this plant, we would like to arrest any concern regarding corrosion or erosion from electrolytic action in this large installation. These and other similar steel evaporators, with copper tubes were the result of over 25 years' experience in the development of all types of salt producing equipment.

A large triple effect evaporator was recently installed at Goderich, Ontario, Canada, to replace a double effect unit. The old evaporators were of the vertical calandria type, constructed of steel, with the exception of the calandria or steam belt section, which was of cast iron and contained many copper tubes. The steel bodies of these old pans withstood the action of the sodium chloride brine, with only slight corrosion for many years, while the cast iron sections were corroded beyond repair.

Several earlier plants have been equipped with steel pans and some of these were checked thoroughly after fifteen years or more of service and were found to be resisting corrosion and in some cases, even better than cast iron. Brine storage tanks made of steel that have been in service since 1913, corroded somewhat, but still in use. Brine evaporators have been constructed, using both ferrous and non-ferrous materials for years. Since the first vacuum pan was installed at Silver Springs, New York, in 1887, evaporators have been built with iron or steel bodies and copper tubes.

We have had the opportunity, through our experience, to examine most of these installations, with these conclusions.

1. That expected ravages of electrolysis are found absent.
2. Corrosion from polysulphides and oxidization are present.
3. Surfaces are generally protected by mixed carbonate and sulphate scales.

We have operated and studied various types of evaporating pans for many years: pans of cast iron with copper flue sheets and tubes; cast iron bodies with iron flue sheets; steel bodies with cast iron steam sections and pans of all steel construction. All types contain copper tubes.

Evaporators of the all-welded type are completely shop assembled, skidded and shipped to point of erection. Four hours after the car was set at the plant site at Goderich, Ont., Canada, the first pan was in place. This unit is 57 ft. high and 12 ft. in diameter across its major section. The approximate weight is 12½ tons. This type of construction has the advantage over that of sectional cast iron, because there is absolutely no air leakage. It is also more economical to construct and erect. It requires less framing support on account of lighter weight. There is also no possibility of cracks developing in flue sheets or other sections as sometimes occur with cast iron evaporators. The covering or insulation can be put on at once and at reduced cost.

This plant is unique in respects other than its welded steel construction. It is the first plant to produce pure bone dry washed salt by a continuous process, from untreated brine.

The brine from the wells is continuously pumped to the evaporators, and the brine salt slurry is continuously pumped to the washing system, which discharges at a constant rate, a uniform slurry to the top feed rotary filter dryer. Here the brine is extracted, and dried to less than one tenth per cent moisture and discharged to the conveying system, which carries the product to the mill for screening and packaging.

C. S. Robinson
Clinton S. Robinson & Associates
Chicago, Ill.

Your Plant NOTEBOOK

DETERMINING CHEMICAL PUMP CAPACITIES FOR LIQUIDS OTHER THAN WATER

By Hugh E. Weightman
Consulting Engineer
Cleveland, Ohio

IN PLANT PRACTICE in the chemical and process industries it is frequently necessary to apply pumps to liquids of considerable viscosity. It is therefore desirable to have some simple means by which the capacity of a pump to be employed may be estimated. It was for that reason the writer set to the task of determining such a means.

Observation has shown that when a centrifugal pump is applied to the problem of pumping oils or other viscous liquids, the capacity of the pump is much less than when pumping water. However, since water is a common medium of reference and usually abundant, pump ratings are given in terms of water capacity.

In plotting data from tests of several types of pump typical of those found in chemical plants it was found that a simple formula would represent the facts. This empirical equation is

$$C = a - b^{\frac{u}{s}} \qquad (1)$$

where C is the capacity at maximum efficiency as a fraction of the pump's water capacity; a equals 2; and b varies from 1.005 to 4.2, the lower figure being for a pump specially designed for handling very viscous fluids. Large chemical pumps have a lower value than do the smaller pumps. It was this lowering of this term with increase in pump size that led to a more useful relation than (1), as shown below. Again referring to the equation, u is the viscosity expressed in poises, s is the specific gravity and u/s is the kinematic viscosity.

Instead of tabulating the various values of b for each size or style of pump a further investigation was made of the test data and the pump construction. Although there were many variables that could account for such changes, one of these stood out above all others. This was the velocity of flow at the eye of the impeller in conventional pump types, or at the narrowest entrance between the impeller vanes. Examination shows that as each style of pump is built in smaller sizes, this velocity increases on account of changes necessary to get the shaft connection in, or, in some cases, to reduce the cost of the pump. Grouping all of the pumps together it was found that b could be represented as a function of this velocity:

$$b = 1.2^{v} \qquad (2)$$

Here v was taken as the velocity at the strangulation point in feet per second. This relation not only held for chemical pumps but also was accurate for a 2-in. water pump in which the impeller was altered to adapt it to the handling of viscous fluids. The factor 1.2 in Equation (2) can be somewhat lowered as the head-capacity curve of the pump is made more steep—that is, if the head falls off rapidly as the capacity increases. The value chosen for this formula was taken as typical of the head-capacity curves of commercial chemical plant pumps, whose curves are quite flat.

By combining (1) and (2) we get:

$$C = a - b^{\frac{vu}{s}} \qquad (3)$$

Because a equals 2 and b is 1.2 as a most suitable value, we can restate the equation in the form:

$$C = 2 - 1.2^{\frac{vu}{s}} \qquad (4)$$

This last equation may be applied to the usual successful makes of chemical pump found in the industry, but caution should be exercised in applying it to typical water pump designs with diffuser vanes and other refinements not found in chemical pumps. It may be applied to pumps with either radial or volute casings. The accuracy of the formula is sufficient for plant practice.

It will be recognized that when $vu/s = 0$, the capacity will be 1.00 or equal to the rated water capacity. When v is of the value usually found in pumps, as u/s approaches the value for water (0.01) the difference is less than the experimental error.

The equations listed above have been based on tests with a short, full-sized suction line. It is evident that if excessively long suction lines or those of small size are used, this will limit the capacity to a lower value than the calculated one. In this case it is necessary to take this loss into consideration as would be done in water-pumping.

What has been said applies to pumps with speeds of 1,000 to 1,800 r.p.m. It is likely that with pumps of higher speed (say of 2,800 to 3,400 r.p.m.) the capacity will be further reduced. There were no test data on this point.

The tests were all made with single-stage pumps. It is probable, however, that there would be similar relations with two- or three-stage pumps.

This same relation may be used for calculating the head for maximum efficiency as a fraction of the head developed for water, but the results will not be as accurate as the capacity calculation when the kinematic viscosity is greater than 3.0; on small pumps of 1 in. discharge and less, it may not be applied at all.

As yet no relation of general application has been found to represent the change in efficiency. As the efficiency drops quite rapidly, ample power must be provided.

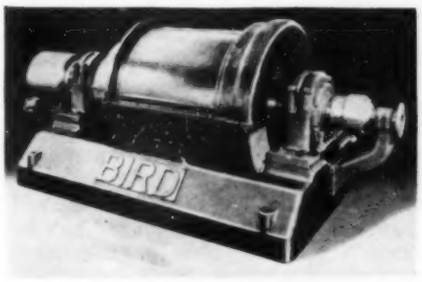
At a later date when facilities are available the writer proposes to go more deeply into these empirical relations, as a means for correcting design data, particularly to determine if possible the relation which the slope of the head-capacity curve bears to the capacity when handling viscous liquids.

A RECENT issue of *Oxy-Acetylene Tips* suggests a simple safety measure easily applied in plants using plain flat steel plates for truckways, walkways, and so on. Such plates wear smooth and become extremely slippery when wet or oily. The remedy is to use an oxyacetylene blowpipe, holding the flame on the plate until the spot just melts, then rapidly moving the flame to another spot so as to produce a series of small pits with hard, rough edges.

News of EQUIPMENT

Solid-Bowl Centrifugal

Bird Machine Co., South Walpole, Mass., whose filtering-type continuous centrifugal was described in the February, 1934, issue of *Chem. & Met.*, has now announced a continuous solid-bowl centrifugal for extracting solids which do not lend themselves to filtration and for clarifying liquors containing such solids. With this machine it is also stated that a differential separation between solids in suspension may be made,



New solid-bowl continuous centrifugal

or that it is possible to take out fractions of solid materials falling within a predetermined range of particle size, or specific gravity, or both.

Depending on the character of the material and the type of separation desired, capacity ranges from ½ to 5 tons of solids per hour, dry weight. Capacities are said to be very high per unit of floor space, while production is continuous and automatic and power costs per ton are stated to be low.

Automatic Adjustable Orifice

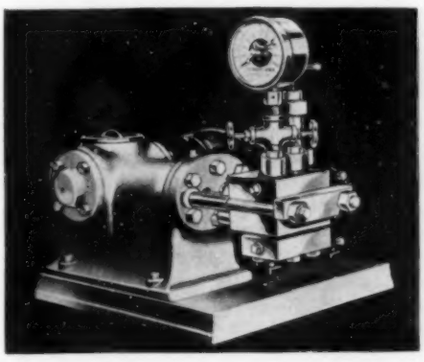
In order greatly to increase the measuring range of its standard recording and integrating flowmeters, the Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio, has developed a two-position adjustable orifice which automatically shifts its position in accordance with major changes in rate of flow. The orifice is similar in appearance to a hydraulically operated gate valve. The gate, however, is a sharp-edged orifice segment which, by varying its position, varies the size of the orifice opening through which the fluid measured must pass. Movable stops are provided to limit the stroke of the piston so that the orifice segment rests in one of two definite positions. The piston which positions the orifice is actuated by a solenoid-operated valve which in turn is commanded by contacts made in the recording meter. Thus hydraulic pressure is admitted to either end of the cylinder while the other end is open to drain.

When the differential pressure across the adjustable orifice reaches a predetermined maximum or minimum, a contactor within the meter cuts the range-changing mechanism in operation, changing the orifice to correspond with the new capacity. Simultaneously, the integrator drive is shifted to a second drive motor so as to continue accurate measurement of flow regardless of the orifice position. An auxiliary recording pen marks the chart so as to show which multiplying factor is to be applied to the corresponding flow record on the chart.

Laboratory Homogenizer

For laboratory use and small production work, Cherry-Burrell Corp., 427 West Randolph St., Chicago, Ill., has recently added to its line of Viscolizers a small capacity laboratory machine

Small-production homogenizer

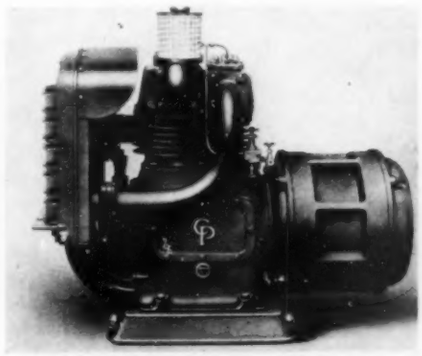


with a capacity of 25 gal. per hour. It is supplied with a 1-hp. motor for plugging into the ordinary lighting circuit. All parts coming in contact with the product are of stainless steel.

The machine consists of a high-pressure pump and homogenizing valve, adapted for operation at pressures ranging from 500 to 5,000 lb. per square inch. Although it was developed for use in connection with the dairy industry and in food processing, the homogenizer is said to be equally applicable to cosmetics, pharmaceuticals, paints, lacquers and other chemical products.

Two-Stage Compressor

A new two-stage compressor, with air-cooled intercooler, designed for high efficiency, reliability, simplicity and low maintenance cost, has recently been introduced by the Chicago Pneumatic Tool Co., 6 East 44th St., New York City. As evidence of the economy of two-stage construction, the manufacturers point to the fact that a two-stage compressor, operating at 100 lb. pressure, requires about 15 per cent less power than an equally well designed, single-stage unit at the same pressure.



Two-stage air-cooled compressor

This compressor is made in four sizes, with two air cylinders used in the smaller sizes and four in the larger sizes. Drive may be by direct-connected motor, by flat belt or by V-belt. A simple unloader is employed which holds open the inlet valve so as to prevent compression when the discharge air pressure rises above the maximum required.

Precision Viscosimeter

Fish-Schurman Corp., 230 East 45th St., New York City, announces that it has undertaken distribution of the Hoeppler Viscosimeter, a device which is said to combine high speed of operation, simplicity of technique and relatively low cost with a degree of precision heretofore unequalled. The instrument measures absolute viscosity

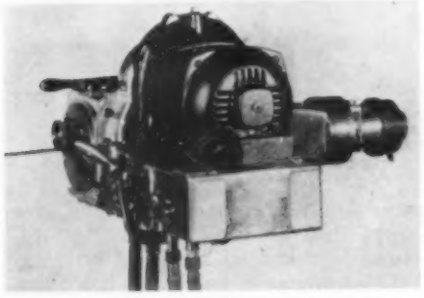
of a fluid by determining the time of fall of an accurately made ball of glass or stainless steel through a column of fluid enclosed in an inclined glass tube of precise internal diameter. A set of six balls is provided to cover the viscosity range from 0.01 to 1,000,000 centipoises. The measuring tube is water jacketed to insure maintaining the desired temperature of the sample.

This viscosimeter is offered in two models, a standard model for scientific measurements of highest precision and an industrial model giving a range of measurement of 0.65 to 100,000 centipoises at an accuracy of plus or minus 0.75 per cent.

Among the advantages mentioned for the new instrument are its speed of operation, its ease of cleaning, and the fact that accurate results may be obtained immediately even by unskilled operators. Measurements may be repeated as often as desired without replacing or transferring the sample.

Metal Spray

Much greater capacity than with earlier equipment is claimed for a new metal spray which has recently been introduced by the Gillord Sales Corp., 420 Lexington Ave., New York City. This equipment is said to handle 12-15 lb. of steel or steel alloys per hour and a correspondingly greater quantity of

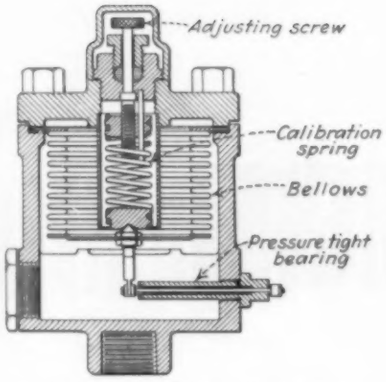


New high-capacity metal spray

other metals, depending on their melting points. The device is constructed so that the metal, which is supplied in the form of standard 9-gage wire, is melted in a small melting chamber within the head of the tool, where it is protected by a neutral gas so that, according to the manufacturer, the grade of metal deposited is better than heretofore possible.

Recording Flowmeter

Differential pressure across an orifice, venturi or pitot tube is measured without the use of a mercury manometer in the recording flowmeter recently developed by Morey & Jones, Ltd., 922 South Hemlock St., Los Angeles, Calif. The differential pressure measuring element is a flexible metallic bellows located in the instrument housing and balanced by a calibrated coil spring. Movements produced by the compression of the spring are transmitted through a pressure-tight bearing and simple linkage to the pen arm. One size of bellows and housing is used for all ranges of differential pressure. To change the range it is only necessary to remove the calibrating spring and substitute another spring for a different range.



Cross section of bellows and housing

The new meter may be supplied with a positive integrator if desired. Other optional equipment includes a pressure pen, an indicating scale and an alarm contact.

Equipment Briefs

Thiokol Corp., Yardville, N. J., has introduced Thiokol D, a new oilproof synthetic rubber with tensile strength up to 1,700 lb. per square inch, elongation around 500 per cent, and extreme flexibility at temperatures as low as —45 deg. F. The new synthetic rubber is said to withstand hot oil at 200 deg. F. It is available in the form of crude sheet.

Several new features in the design of its P.I.V. Gear variable speed transmissions have recently been announced by Link-Belt Co., 910 South Michigan Ave., Chicago, Ill. The improved line consists of five sizes up to 15 hp. capacity. Transmissions are available in either horizontal or vertical types, with or without speed reduction gearing. They may be supplied with integral motors if desired.

Quigley Co., 56 West 45th St., New York City, has developed a new hydraulic insulating refractory concrete, known as Insulcrete, to be used as a poured refractory lining in place of firebrick and insulation. The new refractory weighs approximately 60 lb. per cubic foot, both before mixing and after setting. It is said to have less than half the heat storage of firebrick and to be useful at furnace temperatures up to 2,500 deg. F. Low permeability and negligible shrinkage and expansion are claimed for it. It air-sets in 12 to 24 hours and is said to have high load-carrying capacity. Its thermal conductivity is 3.13 B.t.u. at 1,100 deg. F., compared with a conductivity of more than 2½ times this for firebrick.

Lammert & Mann Co., 223 North Wood St., Chicago, Ill., has announced a new line of control or automatic shutoff valves made in sizes of ⅜ in. and larger. The spring-loaded valve needle and seat are of stainless steel. Packing has been eliminated through the use of a flexible metal bellows. Actuating elements are interchangeable and are of three types: air-operated, steam or water operated and electrically operated. An interlock and manual reset device may be had if desired.

A new welding cable, to which is to be given the name, "Realwear," has been put on the market by the Lincoln Electric Co., Cleveland, Ohio. The conductor consists of fine tinned copper wire laid in rope and stranded. The special rubber compound used for insulation is provided with a woven cotton cover said to be unusually resistant to abrasive action.

For measuring the thickness of non-magnetic coatings such as porcelain enamel, paint and glass applied to plates of iron or steel, the General Electric Co., Schenectady, N. Y., has developed a new electric gage. The instrument consists of a small indicating unit enclosed in a cast aluminum cabinet, and a gage head connected with the unit by cable. Operation of the gage is based upon the reluctance of a magnetic circuit. The greater part of the reluctance is produced by the non-magnetic material, and is hence dependent upon the thickness of the film being measured. Instruments with various thickness ranges between 1 and 100 mils can be obtained.

Greater compactness and increased accessibility are claimed by C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y., for the new No. 40 controller recently introduced by this company. The instrument is available in both indicating and non-indicating types, in nine temperature ranges and three pressure ranges. The improved design follows earlier principles but is said to yield superior sensitivity through refinement and elimination of lost motion.

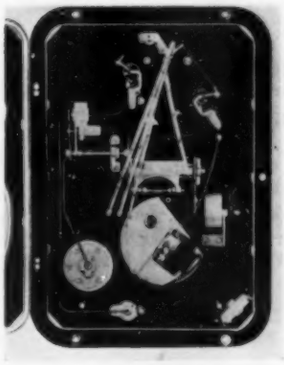
Flexible Coupling

Uniflex is the name given to a new flexible coupling, for both parallel and angular misalignment, recently introduced by the Alloy Products Corp., Waukesha, Wis. The new coupling consists of a driving and a driven hub, each containing two lugs, a floating

fiber disk with slots to receive the lugs and a cover housing. It is stated that the coupling will handle angular misalignment up to 6 deg. and parallel misalignment as great as $\frac{5}{16}$ in. It is further stated that some of these couplings are operating successfully on sprung shafts.

Mechanical Flowmeter

Employing an orifice and mercury manometer as the measuring system, the Bristol Co., Waterbury, Conn., has developed a new mechanical flowmeter said to give precision measurements under severe field conditions. The manometer is of forged steel with uniform cross section. The float motion is transmitted to the pen arm through a grease-packed stainless steel stuffing box lapped to the shaft. The integrator is positive in action, without friction clutches.



Mechanism of new Bristol flowmeter

Meters are available as indicators, integrators, recorders or controllers. Recorders may be furnished with pressure and temperature elements. Integrators are obtainable either with or without static pressure compensation.

Further New Developments at the Chemical Exposition

NOW that the Fifteenth Exposition of Chemical Industries has ended, about 40 new developments have come to light which we had not uncovered in time for inclusion in our November issue (pp. 627-640). In the earlier compilation we noted over 170 developments in plant equipment and construction materials, brought out since the 1933 Exposition. Including those touched on below, the total is 220. Some of those to be mentioned here are of such interest that they cannot be covered adequately in the limited space now available. They will, therefore, be further discussed at a later date.

A number of new pieces of equipment in the field of crushing and grinding were to be noted including a small screen type hammermill made by Raymond Bros. Impact Pulverizer Co., Chicago, Ill. This mill has been designed for easy cleaning, for use in pulverizing colors and dyes. It is supplied with a screw feeder and is designed so that the side plates may quickly be swung out, revealing the entire mechanism for flushing. Williams Patent Crusher & Pulverizer Co., St. Louis, Mo., showed another small hammermill for fine grinding in the range of 100-300 mesh. This is also a screen type pulverizer with screw feed, sealed against the escape of dust, and designed for ready cleaning. A water jacket may be provided if desired. Still another development in a related field is a new belt-driven laboratory and small-production colloid mill for operation at speeds as high as 17,000 r.p.m., shown by the Premier Mill Corp., Geneva, N. Y. This mill is adapted to handling emulsions as well as pasty substances.

New drying equipment not previously described includes two forms of dryer shown by the W. S. Tyler Co., Cleveland, Ohio. This company is now manufacturing the Harmor center-tube, direct-fired, rotary dryer, having also introduced an entirely new Harmor form, a rotary steam-heated dryer with a central heating mandrel which is steam jacketed for direct heat transfer, also serving to preheat the air driven through the dryer. A different sort of dryer, one for gases, was shown by the Pittsburgh Lectrodryer Corp., Pittsburgh, Pa. The model exhibited was a small automatic unit conditioner for reducing humidity in special process rooms, drying cabinets and other equipment. This company's equipment employs activated alumina as the drying agent, over which the air or other gas to be dried is circulated.

Several new pieces of separation equipment were in evidence, the most numerous of these being vibrating screens. Fred S. Carver, New York, showed for the first time a new hydraulic filter press which has recently been installed in considerable numbers in the manufacture of cocoa and chocolate. The filter consists of a horizontal assembly of filtering chambers in which the material is filtered under pump pressure. When the cake has been built up, the entire assembly is subjected to hydraulic pressure of from 500 to 6,000 lb. per square inch. After the material has been thoroughly dried by this means, the pressure is released, the curbs which act as closures to the filter chambers are withdrawn and the cake is automatically ejected. The manufacturer expects the new filter to find considerable application where filter pressing and drying, as separate operations, have formerly been necessary.

Another interesting new filter was the combination pre-filtering and disk filtering unit shown by Ertel Engineering Co., New York. The device, used primarily in the beverage field, combines a plate and frame filter press, using fabric cloths, with an asbestos disk filter for final clarification. Rough filtering, such as the removal of filter aid or activated carbon, is accomplished in the first filtering stage and final polishing in the disk filter.

Most of the screens shown were of the mechanically vibrated types, of which a great many have been introduced in recent years. W. S. Tyler Co. showed a new small Hummer screen, electrically vibrated and adapted to operation from a standard light socket. This company showed an improved vibrating screen as well. Allis-Chalmers Mfg. Co., Milwaukee, Wis., exhibited a flat vibrating screen for use where extremely low headroom is required. Details of the vibrating mechanism have not been released, but it is apparent that the equipment imparts continuous horizontal motion to the material, as well as screening action, permitting discharge of the oversize at the end opposite from the feed. Williams Patent Crusher & Pulverizer Co. exhibited still another new mechanically vibrated screen, featuring easy adjustment of the screening angle. This screen is provided with an indicator showing the angle at which the screen has been set.

Tolhurst Division, American Machine & Metal Mfg. Corp., Brooklyn, N. Y., demonstrated an improved suspension for its under-driven centrifugals. The new suspension is extremely flexible, practically eliminating any vibration which might otherwise be transmitted to the supporting structure.

Two new mixing developments were in evidence. These included a recently improved form of double-motion agitator shown by the Pfaudler Co., Rochester, N. Y. This agitator is of the gate type and is so constructed that there are no bearings submerged in the product. It is said that no vortex is created, which avoids the incorporation of air. Mixing Equipment Co., Rochester, N. Y., in addition to several recent de-

velopments already described in *Chem. & Met.*, showed a small pipe-line agitator for the mixing of materials flowing through pipes. This consists of a right-angled section of pipe equipped with a motor - driven propeller operating through a stuffing box.

In the field of liquid handling an improved rotary vacuum pump, originally developed in Europe, but now manufactured in the United States by Allis-Chalmers Mfg. Co., was shown. This equipment, which is also used for compressing, employs a slotted rotating cylinder with radial vanes eccentrically located within a cylindrical casing. William Powell Co., Cincinnati, Ohio, showed a new hard-rubber-lined valve of the Y type in which a hard-rubber seat and soft-rubber disk are used. The plug is of the free-floating type and all internal parts, including the stem, are protected from contact with the liquid handled.

Materials Handling Equipment

Several new pieces of materials handling equipment were shown, including an improved lift truck, known as Model S, made by Barrett-Cravens Co., Chicago, Ill. This truck is of the multiple-stroke lift type, featuring a construction which makes complete movement of the handle on lifting unnecessary. This company showed a simple new barrel tilter and also an improved barrel and drum rack featuring adjustable rails, adapted to handling barrels of various sizes and constructions. The Lewis-Shepard Co., Watertown Station, Boston, Mass., exhibited an improved low-clearance stacker for drums and barrels. The platform of this machine comes to rest only 2½ in. above the floor. The stacker has been designed for rapid action and automatic stopping at various levels for tiering.

Of the many new developments in instruments at the Show, nearly all were covered in our earlier report. The Foxboro Co., Foxboro, Mass., exhibited an automatic device, the "Vernier Valvactor," for use with automatically controlled diaphragm valves. The device is said to eliminate the effect of stuffing box friction, assuring positioning of the valve exactly in accordance with the dictates of the controlling instrument. This company also showed a new control Stabilog of the potentiometer type. This instrument is equipped with a narrow strip chart and pen to record control deviations. It is stated that the recording is in no way connected with the measuring function and does not affect the sensitivity of the instrument. C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., exhibited an improved air-operated temperature controller featuring a device making possible ready adjustment of the sensitivity of the controller. Through its use the instrument can be regulated for various degrees of process lag.

Several developments in the field of containers and packaging were on exhibit. The Container Co., Van Wert, Ohio, showed an interesting aluminum foil-lined package for fine chemicals. The foil is said to prevent discoloration of certain materials from the fiber used for the package. An additional feature is a rip cord provided for easy opening of the container after it has been sealed. This same company showed a new fiber container for large rolls of material, such as cellulose film. B. F. Gump Co., Chicago, Ill., showed an improved barrel packer which has been redesigned to give greater rigidity to the structure, as well as an increased jolt for faster, denser packing. Pressed Steel Tank Co., West Allis, Wis., demonstrated the development of a new two-ply shell for drums and other containers in which two sheets of metal may be fabricated simultaneously without bonding. The new method increases manufacturing flexibility and makes possible the use of a ply-metal construction with metals which do not yield to bonding processes. Stokes & Smith Co., Philadelphia, Pa., exhibited a combination, two-stage packer and weigher for granular and powdered materials. The container is packed volumetrically at the first station, then the filling completed by an automatic weigher at the second station.

A number of interesting improvements in construction materials were exhibited. General Plate Co., Attleboro, Mass., demonstrated the practicability of laminating gold, silver and platinum with base metals for equipment construction. This is a plying process, comparable to the processes recently developed for combining expensive alloys with base metals. The method has been used for many years in jewelry but is new for industrial purposes. It makes possible the use of precious metal cladding as thin as 0.001 in. on plates, rods and tubes. In the case of the last, the coating may be on the inside, the outside or both. National Carbon Co., New York, showed industrial carbon in a number of new forms including ¼-in. Raschig rings and a carbon tower section, much larger in diameter than any previously produced. This section is about 40 in. o. d. A monolithic carbon tank about 40 in. deep and 48 by 14 in. in cross section was also exhibited. Four grades of a new carbon porous medium for aerators and filters were shown, together with a new carbon bearing, requiring no lubrication or packing, which is under development for use in water pumps. Hazard Wire Rope Co., New York, demonstrated the use of corrosion resisting alloys, such as stainless steel, in wire rope, a development that has been known for some time in marine work, but is new to most chemical engineers. The same company demonstrated corrosion resisting alloy chains made by the American Chain Co.

Corning Glass Works, Corning, N. Y., demonstrated a new all-glass fabric, woven on ordinary textile machinery from glass fibers of 0.00015 in. diameter. The tensile strength of an individual filament is of the order of 1 million lb. per square inch, giving the fabric a much higher strength and greater practicability than has heretofore been obtainable with the fibers previously used, which were about 0.0011 in. in diameter. The new fabric is suggested for liquid filters, bag house filters, electrolytic cell diaphragms and flotation cell blankets.

A number of other developments are not readily classified. Allis-Chalmers Mfg. Co., Milwaukee, Wis., showed a clinker cooler for cement mills which employs a blast of cool air passing upward through a constantly agitated clinker bed of approximately uniform thickness. The clinker is supported on a grate which continuously moves it through the cooler on account of its rapid reciprocating motion. The air so preheated is used for primary and secondary air in the kiln.

"Froth-Flotation" Air Filter

C. O. Bartlett & Snow Co., Cleveland, Ohio, showed a new "froth-flotation" air filter which operates on the principle of the bubble tower, employing, however, but one tray of bubble caps. Air passes upward through the apparatus, bubbling through a layer of water on which is floated a frothing agent. The machine is entirely automatic and is said to show an efficiency not less than 99.8 per cent in removing dust, 25 per cent of which passes a 200-mesh screen. The filter eliminates fire hazard and has no moving parts.

Watson-Stillman Co., Roselle, N. J., showed a new self-contained hydraulic press built in sizes to 100 tons capacity. The base, which supports the press, forms a housing for the pump and motor supplying the hydraulic pressure. Only one lever is required to control this press. Vol-U-Meter Co., Buffalo, N. Y., showed a new outside drum cleaner. Two cup-shaped wire brushes placed at either end clean the heads, while a cylindrical wire brush cleans the side. The drum may be partially immersed in a cleaning solution.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has now equipped all sizes of its linestarters with De-ion grids. This construction was previously used only in breakers. The De-ion design is said to insure high arc rupturing ability.

Chemical Engineering NEWS

Fertilizer Men Draft Fair Trade Practice Program

WITH a registration upwards of 450, members of the fertilizer industry met in Atlanta on Nov. 19, for the fall meeting of the National Fertilizer Association. The opening address was delivered by W. T. Wright who took the place of C. T. Melvin, president of the association, whose death occurred on the preceding day.

Speaking on "Industry Self-Government," Mr. Wright told of the opportunity which the industry has, in the light of past experiences, for governing itself fairly and advantageously under existing law. "As early as 1903 the fertilizer industry tried to work out a satisfactory plan of industry cooperation and self-government. Again in 1921-23 a code of fair competition was worked out for the industry. In 1926 a Code of Fair Practices was developed. While observance of this code was not entirely satisfactory, the experience gained under it was helpful to the industry in its successful operation under the NRA Code which was invalidated, along with other codes, by the Supreme Court decision in the Schechter case.

Mr. Wright pointed out that many of the provisions of the invalidated NRA Code can be employed under existing law. The experience gained under that Code should be utilized to the fullest extent in developing a self-government program which will insure the maintenance of labor standards and the observance of fair trade practice rules, he declared.

This address struck the keynote for the convention as the main purpose of the meeting centered around the industry self-government program which had been developed to take the place of the code which automatically went out of existence with the abolition of NRA.

A few weeks prior to the Southern Convention the plan was completed and submitted to the Federal Trade Commission. The convention last week gave members of the industry a timely opportunity better to familiarize themselves with the completed program.

The annual industry dinner having been cancelled in respect to the memory of Mr. Melvin, James A. Horton, Chief Examiner, Federal Trade Commission, who had been scheduled to give the dinner address, spoke Tuesday morning on the "Promotion of Fair Competition."

He encouraged the adoption of fair trade practice rules and pointed out that the needs of industry may develop in a manner that will broaden the scope of these rules. Rules not now enforceable by law, he explained, may later become Group I rules if it is demonstrated that there is a need for their enforcement at law.

At a meeting of the board of directors on Nov. 20, A. D. Strobhar president of Southern Fertilizer & Chemical Co., Savannah, was elected to fill the unexpired term of the late President Melvin.

A public hearing was held, Nov. 25, before the Trade Practice Board of the Federal Trade Commission on the proposed trade practice rules for the fertilizer industry. The opportunity to be heard was extended by the Federal Trade Commission to all persons affected by or having an interest in the proposed rules.

At the hearing Charles J. Brand, secretary of the association, described the plan for self-government in the fertilizer industry and cited reasons for requesting each of the fair trade practice rules.

Law on Packing Denatured Alcohol Products Changed

AN amendment to Treasury regulations prohibiting packaging of products made from specially denatured alcohol such as bay rum, lilac vegetal, hair tonics, etc., in containers of more than one gallon capacity was issued on Nov. 27, by the Treasury Department.

The amendment reads in part as follows: "Products made from specially denatured alcohol, such as bay rum, lilac vegetal, hair tonics, shampoos, lotions, perfumes, toilet water and similar preparations must be put up and sold by the manufacturer thereof in containers not exceeding one gallon in capacity, except that the supervisor may, in any case where it is shown to his satisfaction that sales in larger packages to legitimate trade are necessary in the proper conduct of the business of any permittee, exempt such permittee from this requirement."

P. E. Buck Appointed Counsel To Alcohol Administration

APPOINTMENT of Phillip E. Buck of Deland, Fla., as general counsel of the Federal Alcohol Administration was announced on Nov. 27, by Franklin C. Hoyt, Administrator. Mr. Buck, succeeds John F. Moore. In March, 1934, Mr. Buck became director of litigation for the National Recovery Administration, and in that capacity directed a large staff of lawyers and handled many hundred cases. For several months he has been a member of the Trade Practice Board of the Federal Trade Commission.

Naval Stores Industry Seeks Subsidy

REPRESENTATIVES of the wood and gum naval stores industry met at Jacksonville, Fla., early in the month to discuss a new marketing agreement for the industry. Control of production, restrictions on tapping of trees, and cooperative marketing were among the topics which were under consideration. The most important development of the meeting was concerned with a proposal to seek a government subsidy.

The naval stores industry of France was given government aid as a result of an appropriation of $300,000 authorized last July. The French decree set an export bounty on French naval stores that amounted to $5.00 a metric quintal (220½ lb.) on shipments of turpentine and 67c. on shipments of rosin. French production of naval stores this year is expected to equal or exceed that for 1934.

Palestine Potash Plant Nears Completion

A REPORT from Joseph L. Brent, consul at Jerusalem, says it is understood that the construction of the southern plant of Palestine Potash, Ltd., will be completed in the near future. Two pumps are now functioning: they are powered by 175 hp. diesel engines and are pumping water over a canal six kilometers long into four evaporation pools of 73 acres each. It is estimated that when the whole plant is completed total production of the company will be in the neighborhood of 100,000 tons of salts annually. The completed plant at the south end of the Dead Sea will consist of 12 evaporation pools, six pumps, and necessary incidental equipment.

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

CANADIAN tariff adjustments are now known. They convincingly prove that Secretary of State Hull has embarked on a course of tariff revision, downward, of course.

The furore which accompanied the announcement of the adjustments made has rather quickly died down in Washington, except the controversy which rages around the forest products schedules. That controversy will undoubtedly continue more or less indefinitely, but it is not expected to occasion any turning back on the part of the Administration. Only a most unexpected upheaval in Congress can now materially change the new rates promulgated on November 18.

Most important to process industry in this series of treaty changes are two principles which were evidently devised for the purpose of protecting the negotiating nations against serious floods of new imports. One of these devices is the quota plan which makes the new tariff rate applicable only to a given quota of goods. The second qualification is found as a reservation in Article XIV, which provides that either Government may withdraw or modify a single concession, if it should prove that extension of the new rate to a third country would unduly increase importations of the article from that new source. By these two devices it is thought that the State Department approaches somewhat closer to the ideals of George Peek, who has been Washington's most ardent advocate of truly bilateral agreements. By this device it is possible that some of the disadvantages which come from most-favored-nation trade treaties may be eliminated.

Olive Branch for Business

The Administration is using Secretary of Commerce Roper as the bearer of olive branches to business. On several recent occasions he has delivered addresses intended to quiet jittery nerves of corporation executives. For example, he has undertaken to prove that only by bigness can many of the useful social services be successfully accomplished. Other speeches make like appeal to certain group interests in the effort to encourage continuance of business improvement.

The Federal Budget also will be formulated with an eye to its consequence on business. The President cannot hope to bring his estimates for the fiscal year 1936-37 even close to balance. But the message to Congress released the first week in January will forecast a deficit for that year much smaller than any of recent times. Business rightly will be encouraged by this evidence of the President's belated recognition of the dangers of excessive spending.

But no amount of forecasting in December or January will preclude a development during the coming session of Congress of legislation which will represent large new commitments for federal expenditure. Some of these, unfortunately those of largest magnitude, cannot even be forecast in time for the budget message. As previously explained in *Chem. & Met.* (Nov., p. 643), decisions of Congress and the Supreme Court leave uncertainties here amounting to several billion. Those issues will have to be faced as they arise, despite the Administration's desire to nurture business, and enlist its political support.

Neutrality

More than ever before it was evident in November that the Administration was unreservedly pressing its neutrality program. With the use of its influence over shipline subsidy recipients and borrowers from the Federal Government, the Administration undertook to prevent movement of petroleum to belligerents. Like effort in restraint of copper, cotton, and other raw materials has been freely predicted in Washington for some time. So long as the President sees the evidence of popular support in this effort, it will be continued.

There may be some embarrassment in pressing projects of this sort when Congress returns in January. The authority of the Executive is limited by law, both in time and as to the type of materials which can be embargoed. Nevertheless, present indications are that Congress, perhaps grudgingly, will continue to leave with the Executive authority to exercise judgment as to when commodities should be restricted in their movement to combatants. It is likely that this authority will not be curtailed merely because other nations have led us to declare petroleum embargoes and then themselves postponed like action with respect to their own national enterprises. Interference with the Executive's action is far more likely to come, if it does, because of home influence by important groups of voters, in copper states, for example.

Labor Trends

Organized labor is moving steadily toward industry unions, as distinct from craft organization. The resignation of John L. Lewis from the vice-presidency of A. F. of L. is but one further step on this course. Thus far the coal miners, headed by Lewis, have not withdrawn from the Federation nor are they likely to immediately; but the threat to do so is forcing reconsideration of the decision reached at Atlantic City in which, apparently, the industrial unionists had lost their battle for another year.

Industrial executives in many lines of business are much more afraid of craft organization than they are of unionization *per se*. They have seen too many jurisdictional strikes to be willing to have Federation organizers come into their industry unopposed. Hence, in many cases when it becomes expedient for further organization of employees, it is more than likely that industry executives will welcome a transfer of ineffective company units into soundly organized industry units. As yet, however, this movement does not seem to have any real significance for the manufacturers of chemicals.

More important to chemical process industry is the labor question involved in the control of coal production. If the Guffey law on which new federal enforcement is being undertaken, subject to court review, has the anticipated effect, there will be substantial increase in the cost of coal to many industrial users. Some have even gone so far as to estimate that the law will occasion an increase of a dollar per ton of coal. If so, process industry users have again confronting them a new set of competitive conditions between coal, petroleum, and natural gas. On the other hand no decisions on this point are expected to be significant until final determination is made by the Supreme Court as to the proper scope of federal activity. Until after that no one can measure with any degree of exactness the probable dollar-and-cent effects on the fuel bill of industry.

Supreme Court

The Administration in its various contests before the Supreme Court is laying greatly increased emphasis on the general welfare clause of the Constitution as the proper legal base for much of the Alphabetic activity. Until several decisions of this session of the Court have been handed down, it is going to be difficult to say how sound

this argument will prove to be. If it fails, then apparently the Administration has no other resort of Constitutional defense. One may expect, therefore, that Constitutional revision would become the next necessary campaign issue of the New Deal reformers.

Greatly exaggerated emphasis has been placed by many observers on the 6 to 3 vote of Supreme Court justices in their decision to grant a temporary injunction against tax collection from processors of agricultural materials pending the determination of AAA legality. This decision has large advantage for business; but it does not at all justify sweeping forecasts as to the repudiation of the New Deal which have been so generously hung on it by casual interpreters.

The greatest importance to those affected by the processing tax is the fact that, pending final decision, the trial court is authorized to take custody of the taxes assessed. This permits the court to refund the sums to the taxpayer if the final court decision is unfavorable to the Government. Thereby the long and complicated procedure of suit in the Court of Claims and appropriation by Congress is nicely avoided. Furthermore, if the taxpayer should lose his suit there will be no penalty against him for delayed payments.

Chemical Show Put On the Air

FOR THE FIRST time in its history of twenty years, the Chemical Exposition went "on the air" Dec. 3 when the red network of N.B.C. broadcast a half-hour of interesting impressions and interviews. The impressions were those of a layman, George Sylvester Viereck, novelist and lecturer. His interviews were with Charles F. Roth, Harrison E. Howe, A. E. Marshall and S. D. Kirkpatrick of the exposition's advisory committee and with H. C. White of the Chemical Foundation, Inc. The broadcast was made from the booth of the Hercules Powder Co.

German Chemical Delegation Visits Exposition

UNDER the leadership of Dr. Herbert Bretschneider of the German Association of Chemical Equipment Manufacturers of Berlin whose Dechema exposition will next be held in 1937, a group of about 30 chemists, engineers and teachers arrived in New York, Nov. 26, for a 10-day visit and inspection tour. Traveling by bus, the party visited Harvard and M.I.T. in Cambridge, Niagara Falls and certain of its industries, Pittsburgh and Mellon Institute, and the U. S. Bureau of Standards in Washington. Returning to New York, Dec. 4, several days were spent at the Fifteenth National Chemical Exposition and in visiting other points of interest. The accompanying photograph of the party was taken in the McGraw-Hill building during an inspection of *Chem. & Met.'s* editorial offices and publishing facilities.

Chemical engineering teachers in the party included Prof. A. W. Schmidt of the Technische Hochschule at Munis, Dr. Richard Heinze, director of the fuel institute at the Technische Hochschule at Charlottenburg-Berlin, and Prof. Tadeus Kuczynski of Poland.

Representatives of the I. G. Farbenindustrie Aktiengesellschaft included Dr. Walter Buchmann, engineer; Dr. Udo Ehrhardt, chemist; Dr. Josef Michel, chemist; and Dr. Max Schulze, works manager; all of Bitterfeld. From the Leverkusen works of the same company came Herbert Finke, engineer, Dr. George Meder, chemist; Dr. Erich Noack, chemist; and Dr. Heinz Thienemann, chemist of the pharmaceutical department. Frankfurt works was represented by Dr. Christoph Kohl, chemist; Dr. Hans Lange, chemist and Carl Mohr, engineer. Dr. Walter Krannich, chemist, of Mannheim completed the I. G. delegation.

The firm of Friederich Krupp A. G. was represented by Dr. Paul Klinger, chief chemist, Heinrich Mueller, engineer, Dr. Paul Schafmeister, department head, Dr. Herman Schottky, chief engineer and Richard Wagner, in charge of apparatus for chemical industry. Other equipment manufacturers and representatives were Karl Hein, of the Walther Feld company of Essen, Dr. Werner Joens, instrument maker of Dusseldorf and Dr. Herman J. Schiffler, chief engineer of Phoenix Tube works of Dusseldorf.

Dr. Max Enderli, director of Rudolph Koepp & Co., Dr. Paul Ferrero, research director of Societe Carbonchemique, S. A., of Brussels, Siegfried Henninger, works manager of Podol Weinzwasser C.R.R. (building materials), Dr. Karl Ladisch, engineer of Nubilosa, of Meissen, Dr. Wilhelm Roehrs, chemist for Bakelite g.m.b.h. of Berlin, Dr. Peter Schlosser, director of the Silesian Verein Chemischer Fabriken and Dr. Otto Bohme were also in the party.

Rosin Standards Modified, Effective Next May

ROSIN standards for the United States have been modified by order of the Secretary of Agriculture, the change to take place on May 6, 1936. The modification is in accordance with the procedure which has been prescribed by the provisions specified and enumerated in the Naval Stores Act.

Changes and improvements in the standards are briefly: Use of a more suitable glass to obtain light transmission qualities or "color composition" more nearly like that of rosin itself; higher brightness for most of the standards nearer that of clean well-strained rosin; more solid, serviceable assembly by cementing the glasses together and by eliminating the metal border around the faces of the standards to obtain a larger viewing face; and respacing of most of the standards to give a more systematic color difference. At present this color difference is too small in some cases, too great in others. Standards for X, N, M, K, I and H will be slightly redder than at present. Those for G, F and E will be a little less red.

German chemical engineers and teachers photographed with Chem. & Met. hosts during inspection of McGraw-Hill Building

Agricultural Chemists Define Fertilizer Terms

AT a meeting of the Association of Official Agriculture Chemists held in Washington in November, the Committee on Definition of Terms and Interpretation of Results on Fertilizers and Liming Materials adopted the following definitions: Final adoption as official—the committee recommends that the water-soluble or available manganese in fertilizers be expressed as manganese (Mn); the term manganese sulphate, when applied to an ingredient of a mixed fertilizer, shall designate anhydrous manganese sulphate ($MnSO_4$); cyanamid is a commercial product composed chiefly of calcium cyanamid ($CaCN_2$), and it shall contain not less than 21 per cent of nitrogen.

Second reading as tentative—Air-slaked lime is a mixture of CaO, Ca $(OH)_2$ and $CaCO_3$ in varying proportions, and it results from exposure of quick lime; pulverized limestone is the product obtained by grinding either calcareous or dolomitic limestone until all of the material will pass a 20-mesh sieve and at least 75 per cent will pass a 100-mesh sieve; ground limestone is the product obtained by grinding either calcareous or dolomitic limestone until all the material will pass a 10-mesh sieve and at least 50 per cent will pass a 100-mesh sieve; superphosphate is a commercial product, the phosphoric acid content of which is due chiefly to mono-calcium phosphate.

First reading as tentative—ammoniated superphosphate is the product obtained when superphosphate is treated with ammonia either alone or with other forms of dissolved nitrogen; primary fertilizer components are those at present generally recognized by law as necessary to be guaranteed in fertilizers; namely, nitrogen, phosphoric acid, and potash; secondary fertilizer components are those other than the "primary fertilizer components" which are essential to the proper growth of plants and which may be needed by some soils. Some of these components are: sulphur, manganese, magnesium, copper, zinc, boron and calcium.

Air Hygiene To Be Studied At Mellon Institute

AIR Hygiene Foundation of America, Inc., has been formed by a large group representing various industries, with headquarters at Thackeray Ave. and O'Hara St., Pittsburgh, Pa. The purposes of this organization are to conduct investigations of and to stimulate research on problems in the field of air hygiene and to gather and disseminate factual information relating thereto. It will also cooperate with and assist other agencies active in this field and will collaborate in the coordination of such research efforts. A comprehensive investigation has been begun at Mellon Institute of Industrial Research, Pittsburgh, under support of Air Hygiene Foundation of America, in which the hygienic, technologic, and economic aspects of air contamination, especially by dust in the industries, will be studied.

H. B. Meller, who has been appointed managing director of the Foundation, will head this investigation at Mellon Institute. Mr. Meller has been active in research on air pollution since 1920 and is generally regarded as an authority on that subject.

In this investigational work, Mr. Meller will be aided by Dr. F. F. Rupert. The latter has been an Industrial Fellow of Mellon Institute since 1913, specializing in the field of physical chemistry. During the past three years he has made studies of air pollutants and especially of dusts, working with Mr. Meller; he has also carried out a number of plant investigations, in the course of which he has evaluated procedures for determining and controlling industrial dusts. Other assistants will be added to the staff as the work progresses.

Italy Makes Synthetic Wool From Casein

THE manufacture of "synthetic wool" from casein, has now passed the experimental stage in Italy and is being produced on an industrial scale, according to a report to the Commerce Department from its Rome office.

In the manufacture of this new product, casein, which is extracted from skimmed milk by the usual method, is subjected to a bath of chemicals in which it is soluble, and the resulting viscous solution is forced through small holes which form the "woolen" threads, as in the production of rayon or synthetic silk, the report states. In fact, except for the chemical treatment for which special apparatus is required, the wool is produced with the same equipment used for the production of rayon.

It is claimed by the inventor that owing to the smaller percentage of sulphur, which tends to reduce the warmth of natural wool, the synthetic product possesses even greater heat-conserving qualities than natural wool, and that for the same reason the new fiber takes dye more evenly.

As with rayon this new casein product can be produced in the fineness and length of staple required, assuring the highest degree of perfection in the finished cloth, the manufacturer claims.

It is said that one pound of coagulated skimmed milk will produce one pound of "synthetic wool" and that the cost of production will be governed largely by the cost of casein.

Mechanical Engineers Hold Several Process Sessions

PROCESS industries activities, which, according to a recent survey of the membership of the American Society of Mechanical Engineers, now occupy fourth place in the professional interests among the organization's members, held a prominent place on the program of the A.S.M.E. annual meeting, held during the week of Dec. 2, in New York. Several of these papers were given under the auspices of the new but rapidly developing process industries division. Others of equal interest to process engineers were presented by the applied mechanics, iron and steel and petroleum divisions and by the A.S.M.E. members of safety and boiler-feed committees.

An outstanding contribution to the process group was a paper on the double-eddy-current type of dust collector, presented by H. van Tongeren, of Holland. Two sugar papers given before the division included one by H. L. Webre, on the formation and growth of sugar crystals in vacuum pans, and a second, by R. P. DeVries, on the design and operation of automatic pan control. The division's heat transfer committee continued its important contributions to the literature of heat exchange with a symposium of seven papers on radiant heat, including among the authors J. E. Eberhardt, H. C. Hottel, V. C. Smith, W. Trinks, J. D. Keller, R. H. Heilman, M. A. Cooper, E. O. Mattocks and A. E. Hershey. Five papers on creep of metals, and four on occupational diseases were of further interest to process men, together with papers on control apparatus in petroleum refineries, and on heat recovery in refineries.

Rumored as a session of startling disclosures regarding caustic embrittlement, the meeting of the joint committee on boiler feedwater turned out to be one of friendly and nearly complete agreement among the several entries. For several years, since Prof. F. G. Straub, of the University of Illinois, first announced his proofs of caustic embrittlement of steel, numerous reports of non-agreement and inability to reproduce his findings have appeared. Work is by no means completed, but it now appears that caustic soda without the presence of silicate in the solution cannot cause embrittlement; that when less than a maximum and more than a minimum of silicate is present, embrittlement will occur at normal boiler temperatures and pressures. However, faulty riveting may give the appearance of embrittlement. Thus far, results of the U. S. Bureau of Mines, at the New Brunswick Experiment Station, confirm Prof. Straub in his latest work. More will be heard later on this interesting and, until recently, controversial subject.

NAMES *in the News*

R. T. Conger

Chaplin Tyler

RAYMOND T. CONGER, president of Conger & Co., engineers of Osaka, Japan, recently spent several months in the United States renewing business and professional acquaintances in Chicago, Pittsburgh and New York City. As one of the founders of the professional chemical fraternity, Alpha Chi Sigma, he was interested and surprised to learn of the extent of that organization's growth and influence.

W. C. ASHLEY, formerly with the Eastman Kodak Co. in the division of applied chemistry, has joined the technical staff of Battelle Memorial Institute.

C. F. SCHMARJE, formerly research assistant at Iowa State University, has joined the staff of Battelle Memorial Institute at Columbus. Other recent appointments include M. L. Samuels, J. A. Lowther and Lloyd R. Jackson.

GASTON J. LEY has joined the staff of the Hawaiian Agricultural Experimental Station at Honolulu. He will work on the commercial development of products from taro root.

MISS JANET SEARLES has joined the staff of the R. & H. Chemicals Division of E. I. duPont de Nemours & Co. She will be located at Niagara Falls.

ROBERT L. BALDWIN is now sales development manager of the electrode division of National Carbon Co. He will continue to maintain his headquarters at Niagara Falls.

CHAPLIN TYLER has recently been made assistant director of the publicity department of E. I. duPont de Nemours & Co. Since 1927 he has been with the Ammonia Department as chemist, research supervisor and sales development manager. Before joining the duPont organization Mr. Tyler was assistant editor of *Chem. & Met.* and research associate in applied chemistry at M.I.T.

EDWARD A. HAHL has been appointed to a position on the engineering staff of the American District Steam Co. of North Tonawanda, N. Y.

D. B. AYESST is returning to Canton, China, where he will superintend an installation of Vorce cells for the Reconstruction Department of Canton.

HENRY URANIAN, a graduate of the University of Richmond, has been selected to become chief chemist of the laboratory of the Chesapeake Corp. at Richmond, Va.

JOHN V. SCUDI is now with the research organization of the Krebs Pigment and Color Corp., at Newark, N. J.

JOHN G. DITMAN has accepted a position with the Standard Oil Co. of New Jersey.

FREDERICK M. REINHART, recently at New York University, has been appointed to a position in the Experimental Station of the Bureau of Mines at Pittsburgh, Pa.

H. W. PUTNAM has accepted the position of chief chemist with Igleheart Bros., Evansville, Ind.

NORMAN A. SHEPARD, chief chemist of Firestone, has been elected chairman of the rubber division of the American Chemical Society.

ERIC ZIMMERMAN, formerly in charge of the laboratory of the Chesapeake Corp. and the Albemarle-Chesapeake Co., has been recently appointed pulp mill superintendent. Mr. Zimmerman graduated at Upsala and specialized in pulp and paper at the Royal Institute of Technology at Stockholm. He was apprentice at the Scandinavia sulphate mill in Sweden and has been with the Chesapeake organization since 1928.

JOHN E. HOCUTT has been appointed instructor in the chemical department at the College of William and Mary.

JOHN PRIMROSE, who has been vice-president of the Foster Wheeler Corp. since it was organized, has been elected to the office of vice-chairman of the board following the resignation of Pell W. Foster. In 1901, Mr. Primrose became chief engineer of the Power Specialty Co. and subsequently vice-president in charge of oil refinery activities.

WM. R. GREEN, chief chemist of the Continental Baking Co., Kansas City, has been elected chairman of the local section of the American Association of Cereal Chemists.

M. D. MIZE has accepted a position on the technical staff of Wallace & Tiernan, Belleville, N. J. Mr. Mize was formerly with the Omaha Grain Exchange, Omaha, Neb.

ROBERT E. PARKINSON has recently joined the staff of Battelle Memorial Institute, Columbus. Mr. Parkinson was formerly with the Inland Steel Co. He has been assigned to the division of physical metallurgy at Battelle.

R. G. PRIDMORE has been appointed assistant agronomist by the American Potash Institute, Washington, D. C. After graduating from Clemson College he was assigned to Sandhill Experimental Station, near Columbia. In 1930 he became engaged with the Superphosphate Institute of Washington as assistant field agronomist conducting fertilizer experiments on cotton in South Carolina, Georgia and Alabama.

EARLE W. MCMULLEN became director of sesearch of the Eagle-Picher Lead Co. on December 1. This position formerly was held by Dr. John A. Schaeffer, who resigned to become pres-

ident of Franklin and Marshall College. Since 1909, when Mr. McMullen graduated from Armour Institute of Technology with the degree of bachelor of science in chemical engineering, he has been director of research and technical processes at the Simmons Co., in the technical organization of the Celotex Co., and vice-president of and plant manager of the Ault & Wiborg Corp.

E. D. BRANSONE has been elected president of the Vanadium Corp. of America. He has been coordinator of business relations of the Air Reduction group.

ROBERT E. VIVIAN left the research staff of General Chemical Co. to accept the position of director of research for Metals Disintegrating Co., Elizabeth, N. J.

CARL F. PRUTTON has been appointed by the board of trustees of Case School of Applied Science to succeed Dr. W. R. Veazey as head of the department of chemical engineering. Dr. Prutton was graduated from Case in 1920 and later did graduate work at Western Reserve University. In 1930 he became an associate professor at Case and early this year he was advanced to full professorship.

F. SWIFT GIBSON of Baltimore has been elected president of Virginia-Carolina Chemical Corp. He has been active in the fertilizer industry for 20 years.

C. BRIAN WAINWRIGHT has joined Merck & Co. He will have charge of research development of textile specialties. Mr. Wainwright was, for four years, chief chemist and technical director of the Apponang Co.

C. F. BURGESS has been named chairman of the board of the laboratories carrying his name. This is a newly created position. ARBA B. MARVIN of New York has been elected president. The new president was an organizer of the company and has been its attorney for more than 20 years.

HENRY W. FOULDS has been elected vice-president of the Permutit Co. L. S. FERGUSON, a chemical engineering graduate from the University of Illinois in 1915, will assist Mr. Foulds as manager of industrial sales.

EDWARD E. MARBAKER of Mellon Institute has been elected chairman of the newly formed Pittsburgh Section of the A.I.Ch.E. Other officers are: JUNIUS D. EDWARDS of the Aluminum Co. of America, vice chairman and W. W. DUECKER of Mellon Institute, secretary and treasurer.

G. H. B. DAVIS has become director of the Esso Laboratories of the company, at Elizabeth, N. J. H. W. FISHER, formerly assistant manager of the Esso Marketers sales engineering department, will succeed Mr. Davis as assistant director of the laboratories.

JEROME STRAUSS, who recently was elected vice-president in charge of research and development for the Vanadium Corp. of America, has been affiliated with the company for the past seven years. His previous connections included the Illinois Steel Co., the Western Drop Forge Co. and the Ordnance Department of the army. He holds a commission of lieutenant commander in the U. S. Naval Reserve.

GEORGE E. WALKER, formerly assistant manager and technical director of Southern Mineral Products Corp., Piney River, Va., and recently consulting editor of *Chem. & Met.*, is now in charge of the soya protein division of the Glidden Co. at Chicago, Ill. Plans for manufacture of a number of soya protein products having important use in the paper, glue, paint and plastic industries, are the outcome of several years research and development of Glidden under general management of W. J. O'BRIEN, vice-president.

HAROLD C. UREY, professor of chemistry at Columbia University and winner of the Nobel Prize in chemistry for 1934, has been honored again. He has been made the recipient for 1935 of the Columbia Lion, an honor awarded by the Affiliated Columbia Alumni Clubs of New Jersey to an outstanding citizen of that state, who has brought honor to the University through conspicuous world service and noteworthy achievement.

KENNETH A. KOBE, assistant professor of chemical engineering at the University of Washington, has been made vice-president in charge of research and testing of the recently formed Chemical Engineering Co. of Washington, Seattle.

A. D. STROBHAR, president of Southern Fertilizer & Chemical Co., Savannah, has been elected president of National Fertilizer Association for the unexpired term of the late President Melvin.

GUSTAVUS OBER, JR., has been elected executive vice-president of Virginia-Carolina Chemical Corp. In recent years he has served as chief executive officer of G. Ober & Sons Co., Baltimore.

R. D. SAKLATWALLA, who was vice-president of the Vanadium Corp. of America until recently, has been made president of the U. S. Rustless Steel & Iron Corp., Pittsburgh.

PER K. FROLICH, formerly director of the Esso Laboratories, has now been made chief chemist of the Standard Oil Development Co. In this capacity he will contact the various laboratories of the company, both here and abroad, serving as an advisor in technical and patent matters.

OBITUARY

HANS TROPSCH, associate director of research of Universal Oil Products Co., Chicago, and one of the world's leading research chemists, died October 8 in Essen, Germany, after an illness of several months.

Hans Tropsch

Dr. Tropsch was a world authority on coal and oil chemistry, particularly catalytic hydrogenation of carbon monoxide from coal to produce gasoline and other oils. From 1920 to 1928 he was associate director of the Kaiser Wilhelm Institute for coal research, in Mülheim-Ruhr. In the latter year Dr. Tropsch was commissioned by the Czechoslovakian government to organize and head a national coal research Institute in Prague. He was director of that institute until 1931 when he came to this country to join the research staff of Universal Oil Products Co. In addition to his work with Universal, he was also a professor of chemistry at the University of Chicago and at Armour Institute, Chicago.

WILLIAM GOODSON AMES, a prominent engineer in the sugar refining industry in Cuba and Florida, died at Tucson, Ariz., after a lengthy illness. He was 62 years of age.

Born in White Hills, Ky., he was a graduate of Vanderbilt University. Mr. Ames helped to form the Havana engineering firm of Smith & Ames, which

over a 15-year period designed and built many large Cuban sugar refineries. For several years, beginning in 1926, he was in charge of the construction of the Southern Sugar Co.'s raw sugar house at Clewiston, Fla.

WILLIAM C. READ, metallurgist of Union Carbide and Carbon Research Laboratories, died suddenly in New York, November 6, at the age of 47 years. Mr. Read was graduated at Massachusetts Institute of Technology in the class of 1909. He had been associated with the Union Carbide organization for over 25 years, particularly in metallurgical research.

CHESTER T. MELVIN, president of the National Fertilizer Association, died November 19. He was born October 19, 1883.

Mr. Melvin had been connected with the Imperial Co. of Norfolk, the Virginia-Carolina Chemical Co. at Savannah and Albany, Ga., and Jacksonville, Fla., and the Gulf Fertilizer Co. at Tampa. He was also in later years president of the Peninsular Chemical Co. of Orlando, Fla., and of the Tampa Pine Products and Chemical Co.

HAROLD NORMAN SPICER, a director of the Dorr Co., New York, died November 8 at his home in this city. He was in his seventy-first year. In 1911 he joined the Dorr Cyanide Machinery Co. of Denver, now the Dorr Co.

WALTER TREAT WALKER, vice-president in charge of sales of the Kimble Glass Co. of Vineland, N. J., died suddenly at White Sulphur Springs, W. Va., October 2. Mr. Walker was 52 years of age.

FREDERICK W. WEISSMANN, former supervisor of lectures in technical chemistry in the University of Cincinnati, died October 9 at Karlsbad, Germany, where he had gone last May for his health.

GEORGE W. FORTMEYER'S funeral services were held at East Orange, N. J., on the evening of December 5. Mr. Fortmeyer died three days earlier at Stony Point, N. Y., where he had resided for most of the time since his retirement from the National Lead Co. From his early years Mr. Fortmeyer was connected with the white lead and linseed oil trade and at the time of his retirement was manager of the Atlantic Branch and a director of the National Lead Co. For several years he was president of the New York Linseed Association. He was a former president of the Paint, Oil and Varnish Club of New York, a member of the Drug and Chemical Club, and the Downtown Club. He was in his 97th year.

JOSEPH TURNER, head of Joseph Turner & Co., New York, and for more than half a century associated with the chemical industry, died at his home in Ridgewood, N. J., on November 17. Mr. Turner was born in England but came to this country as a boy and started work as office boy for J. L. & D. S. Riker. In 1915 he became general manager of the firm and in 1923 took over the business under the name of Joseph Turner & Co.

Mr. Turner served on the Chemical Warfare Board during the war. His clubs included the Chemists Club, the Drug and Chemical Club, the Columbia Yacht Club, Long Bay Shore Yacht Club, Long Key Fishing Club, and the Ridgewood Country Club.

CALENDAR

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, annual meeting, New York, Feb. 17-20.

CANADIAN CERAMIC SOCIETY, annual meeting, Toronto, Feb. 17-18.

AMERICAN CHEMICAL SOCIETY, Kansas City, Apr. 13-17.

ELECTROCHEMICAL SOCIETY, annual meeting, Cincinnati, Apr. 23-25.

INTERNATIONAL CHEMICAL ENGINEERING CONGRESS, London, England, June 22-27.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 29-July 3.

Data on RFC Loans Made To Domestic Industries

FIGURES released by the Reconstruction Finance Corp. give a picture of the direct loans made to American trade and industry from the inception of the program on June 19, 1934, to the close of business on September 30, 1935. Later figures are not yet available but it is understood the volume of business is showing a distinct decrease because of the growing willingness of the banks to take back the burden of industrial finance.

During the period covered RFC authorized 1,514 loans aggregating $94,045,778.54, an increase of 567 loans involving $44,055,321.61 since the last report, which covered the program to June 30, 1935. The latest report gives a breakdown by size of loans as follows:

Size of loan	Number of Loans	Amount Authorized
$10,000 and under	565	$3,167,592
$10,001 to $25,000	276	5,170,350
$25,001 to $50,000	284	11,423,850
$50,001 to $100,000	200	15,753,487
$100,001 to $200,000	100	15,386,500
$200,001 to $400,000	59	18,114,000
Over $400,000	30	25,030,000

Industries and trades borrowing from RFC cover a wide range, as the following table shows:

Manufacturing	Number of Loans	Amount
Food	183	$6,500,950
Textiles	185	19,453,100
Lumber	205	11,873,550
Paper	29	6,132,850
Printing	48	623,350
Chemicals	43	2,153,800
Rubber	12	1,128,500
Leather	30	2,096,927
Stone, Clay, Glass	106	6,726,400
Iron and Steel	94	10,253,015
Non-ferrous Metals	56	3,218,300
Machinery	96	6,083,067
Transportation Equipment	34	4,315,000
Total (manufacturing)	1,121	$80,558,809

Production, Consumption, and Stocks of Vegetable and Fish Oils

KIND	Factory Operations for the Quarter Ended Sept 30, 1935 Production (lb)	Consumption (lb)	Factory and Warehouse stocks Sept 30, 1935 (lb)
VEGETABLE OILS[1]			
Cottonseed, crude	194,442,409	154,428,719	74,537,279
Cottonseed, refined	140,552,523	360,590,426	287,346,578
Peanut, virgin and crude	1,466,650	21,416,994	19,486,198
Peanut, refined	19,702,185	26,541,254	12,766,543
Coconut or copra, crude	61,569,091	130,394,547	109,836,001
Coconut or copra, refined	91,344,526	101,105,015	23,560,153
Corn, crude	23,297,371	32,872,180	13,808,495
Corn, refined	28,005,485	7,142,293	7,517,232
Soy bean, crude	18,993,017	20,747,205	9,799,181
Soy bean, refined	16,533,542	19,979,955	4,076,630
Olive, edible	.....	588,019	1,979,938
Olive, inedible	.....	2,743,533	2,561,695
Sulphur oil or olive foots	.....	5,599,901	16,653,808
Palm-kernel, crude	[2]	16,887,407	31,477,186
Palm-kernel, refined	5,105,668	4,990,117	1,317,780
Rapeseed	.....	10,172,397	14,481,544
Linseed	116,666,553	73,812,243	106,331,974
Chinese wood or tung	.....	27,214,084	19,399,816
Perilla	.....	11,545,934	24,924,468
Castor	10,345,410	5,940,114	7,983,346
Palm	.....	66,585,248	68,144,822
Sesame	17,409,769	18,507,970	22,740,607
Sunflower	.....	5,597,077	2,675,531
All other	[3] 12,722,507	7,370,338	9,391,956
FISH OILS:[1]			
Cod and cod-liver	399,539	4,840,665	11,491,160
Other fish oils	[4] 62,544,496	51,124,272	127,921,449
Marine animal oils	[5] 4,305,000	7,381,182	48,502,898

[1] The data of oils produced, consumed, and on hand by fish oil producers and fish canners were collected by the Bureau of Fisheries

[2] Included in "All Other" vegetable oils

[3] Includes 3,791,526 lb. hemp seed oil.

[4] Includes 41,014,092 lb. herring and sardine, and 19,713,672 lb. menhaden oil, and 1,816,732 lb. miscellaneous fish oils.

[5] Includes 973,875 lb. sperm oil and 3,331,125 lb other whale oil.

Chemical ECONOMICS

ACCORDING to the report of the Federal Reserve System industrial production increased more than seasonally in October and there was also a considerable advance in factory employment and payrolls. There was a continuous inflow of gold from abroad and an increase in bank deposits.

Volume of output at factories and mines, as measured by the seasonally adjusted index of industrial production, increased from 89 per cent of the 1923-1925 average in September to 94 per cent in October, reflecting larger output in a wide range of industries. Automobile production, which had been at a low level in September when preparations were being made for the manufacture of new models, increased rapidly during October and the early part of November. At steel mills, activity increased slightly in this period, contrary to the usual seasonal tendency, and in the third week of November was at about 54 per cent of capacity. Lumber production showed little change. Among the industries producing nondurable manufactures, the principal changes in output were increases of considerably more than the usual seasonal amount at cotton mills, woolen mills, and meat packing establishments. At mines output of bituminous coal was in larger volume than in other recent months and output of crude petroleum continued to increase.

Factory employment, which ordinarily shows little change at this season, increased considerably between the middle of September and the middle of October, reflecting substantial increases in the industries producing durable manufactures. The most marked expansion was in the automobile industry and there were smaller increases at railroad repair shops and in the iron and steel, machinery, and nonferrous metals industries.

While there was some recession in activity at textile plants, it is estimated that consumption of cotton in November ran in excess of 500,000 bales, whereas the total for November, 1934, was 480,000 bales.

Takings of raw silk by American mills during November ran considerably behind October, and also slightly under November of last year, according to statistics furnished by the National Federation of Textiles, Inc. The total was 37,012 bales, against 48,167 in October, a drop of 11,155 bales. Compared with November, 1934, there was a drop of 536 bales.

Deliveries of carbon black in November reflected the higher rate of operations in the rubber trade and also in the lacquer trade, a condition which goes back to the automotive industry which had pushed ahead its season. In the case of demand for carbon black it was stated that the shipments in November had run close to one-third more than in November of last year and were larger than October shipments by about 15 per cent.

Current demand for rayon is on a plane higher than had been anticipated partly because sales of finished products employing rayon have exceeded estimates and partly because the possibility of labor troubles has stepped up production of the finished goods and thus created a wider demand for the raw material.

Improvement in building and automotive lines has kept the glass trade active and all lines except glass containers are reported to be operating at a very high rate for this time of year. In fact, glass production at present is said to be moving ahead at a rate higher than had been reached in any previous month of this year.

Consumption of crude rubber by manufacturers in the United States for October is estimated to be 42,436 long tons, which compares with 37,553 long tons for September, 1935. October consumption shows an increase of 13 per cent above September this year and 35.8 per cent above October a year ago, according to Rubber Manufacturers Association. Consumption for October, 1934, was reported to be 31,253 (revised) long tons.

The Bureau of Mines reports that in October coke ovens recovered tar to the amount of 40,528,897 gal. as compared with 37,643,342 gal. in September and 30,972,321 gal. in October last year. Total to the end of October was 370,094,644 gal. as compared with 351,637,357 gal. in the same period, 1934. Light oil yield was 12,757,701 gal. as compared with 11,840,096 gal. in September and 9,741,836 gal. in October. Total for the ten months was 116,407,109 gal. as compared with 110,601,771 gal. last year. Ammonia sulphate equivalent of all forms was recovered to the extent of 47,930 tons as compared with 44,738 tons in September and 35,100 tons in October last year. Total to the end of October was 429,803 tons as compared with 400,700 tons in the corresponding period of 1934.

Benzol production was estimated at 7,303,000 gal. as against 6,799,000 gal. in September, and 4,711,000 gal. in the same month a year ago. Total to the end of October was 63,299,000 gal. as compared with 57,268,000 gal. in the corresponding period a year ago.

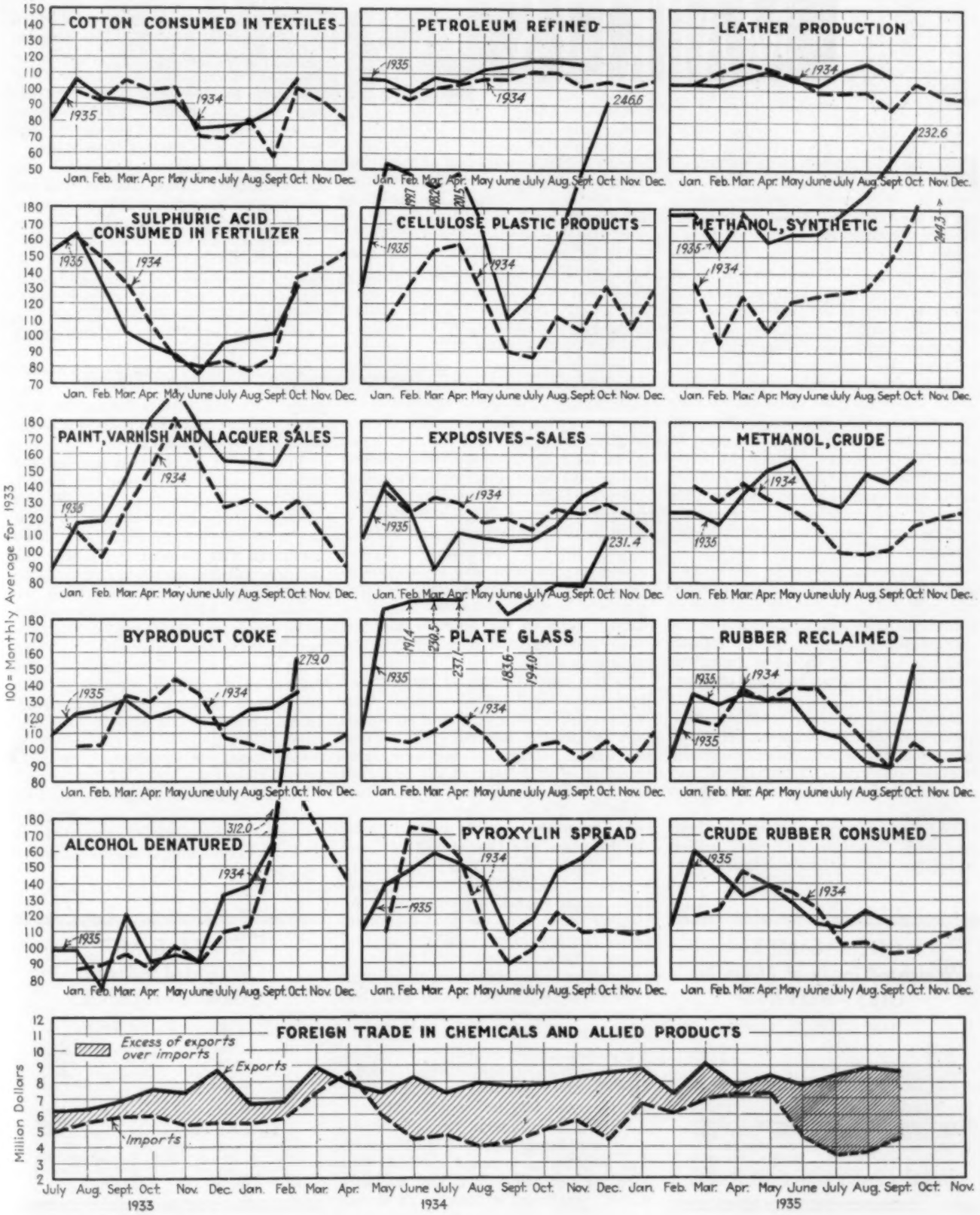
Caustic soda production in Japan has increased considerably in 1935. The Japanese Bleaching Powder Producers' Association reports output of caustic soda for sale by members during 8 months of 1935 at 50,456 metric tons and of bleach at 44,576 tons, representing gains of 13,664 and 4,575 tons, respectively, over the corresponding period of 1934. Because of active demand for bleach by paper manufacturers in Saghalien, production restrictions were cut 10 per cent in October, to 45 per cent of capacity. This accounts for our decline in exports to that country.

Production and Consumption Data for Chemical-Consuming Industries

	Oct. 1935	Oct. 1934	Jan.-Oct. 1935	Jan.-Oct. 1934	Gain Jan.-Oct. 1935 over Jan.-Oct. 1934 Per Cent
Production					
Alcohol denatured, 1,000 wi. gal	17,160	19,194	79,249	76,290	3.9
Automobiles, No.	275,021	131,991	3,204,066	2,516,005	27.3
Byproduct coke, 1,000 tons	3,052	2,312	27,789	25,515	8.9
Glass containers, 1,000 gr.	3,603	3,132	32,443	29,877	8.6
Plate glass, 1,000 sq.ft.	16,593	7,512	147,795	76,831	91.2
Methanol, crude, gal.	406,950	297,759	3,587,483	3,097,301	15.8
Methanol, synthetic, gal.	2,508,978	1,309,086	14,018,660	9,442,613	48.5
Cellulose acetate plastics, 1,000 lb.	1,299	449	8,291	4,057	104.4
Nitrocellulose plastics, 1,000 lb.	1,660	1,131	13,448	10,323	30.3
Pyroxylin spread, 1,000 lb.	5,125	3,325	43,516	37,319	16.6
Steel barrels, No.	893,831	583,151	5,716,435	5,786,638	1.2*
Sulphuric acid in fertiliser trade, tons	149,729	149,968	1,328,070	1,187,671	11.9
Consumption					
Cotton, 1,000 bales	552	523	4,625	4,524	2.2
Silk, bales	48,167	49,106	424,572	383,217	10.8
Explosives, sales, 1,000 lb.	29,498	26,892	232,912	245,726	5.2*
Sulphuric acid in fertiliser trade, tons	131,441	137,357	1,085,327	1,100,499	1.4*

*Per cent of decrease.

TRENDS OF PRODUCTION AND CONSUMPTION



FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Million Dollars
Excess of exports over imports
Exports
Imports
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov.
1933
1934
1935

The MARKETS

PRINCIPAL interest in the market for chemicals in the last month has centered in the price situation surrounding prices for contracts covering 1936 deliveries. In many cases there has been a tendency to include provisions for adjustment of prices after the first quarter or first half of next year in cases where the contracts involved delivery over the full 12 months period.

In some instances, new contract prices have not yet been announced but the trend to date has been toward higher levels. Lower figures were named some time ago for zinc oxide deliveries and phosphates of soda have continued to meet with competitive selling. In nearly all other cases the market has maintained a firm tone with higher prices quoted for chlorine, bleaching powder, copperas, naphthalene, benzol, betanaphthol, and bichromates of soda and potash.

Such important items as white lead, soda ash, caustic soda, chlorate of soda, carbon black, and sulphuric acid hold an unchanged price course although in the case of sulphuric acid, prices actually paid are higher as the open quotations for the last three years were not observed in transactions.

Because of better-than-seasonal activities in some of the consuming fields, call for chemicals has held up well especially from the rubber, glass, metallurgical, and oil refining trades with a mixed trend in textiles.

The market for naval stores has been easy with turpentine and rosin selling off but the industry has been taking steps toward a better unification of the industry especially with reference to control of production and cooperative marketing and the market may improve as a result even though government-held stocks are yet to be liquidated. The current rosin holdings of the Government total about 293,000 barrels and the turpentine under loan 148,609 barrels. The face amount of the loans on these naval stores is approximately $5,800,000.

Contract business in chemical pigments is reported to have reached a large volume. Sometime ago, prices for zinc oxide were reduced because of competitive conditions and as the lower prices were regarded in some quarters as likely to be in effect only for a limited period, there was a disposition on the part of many large consumers to cover future requirements and even to increase their normal takings. A very satisfactory business also is credited to the market for titanium oxide—a pigment which established a new record for sales volume in the present year and which promises to do even better in the coming year.

In the case of some of the coal-tar products, revised quotations have been devised with a view of giving an advantage to quantity buyers. For instance the new schedule for technical betanaphthol is on a basis of 24c. a lb. for lots of 5,000 lb. or more with a premium of 1c. a lb. for less than 5,000 lb.

In a summary of recent world chemical developments, the Department of Commerce reports that German farmers spent a total of 636,100,000 marks for fertilizers during 1934-35, an increase of 64,500,000 marks over the preceding fiscal period, a report from Frankfort-on-Main states. While consumption of all classes of fertilizer materials increased, nitrogen showed the largest percentage gain, and Chile, which according to the provisions of the nitrate cartel agreement is entitled to supply around 3½ per cent of Germany's nitrate consumption, has been granted a supplementary import quota of 5,120 metric tons of duty-free sodium nitrate.

Reports from Madrid state that Spanish potash output totalled 131,648 metric tons in 1934, an increase of 40,535 tons over the preceding year, and statistics recently published in Moscow show that Soviet fertilizer production has increased enormously in recent years. Nitrate production in Chile, while still below that of former years, totalled 1,133,000 metric tons in 1934-35 compared with only 536,000 tons in the preceding fiscal period and 450,000 tons in 1932-33.

Italian Ministerial Decrees published on October 21, authorized the erection of 10 new chemical plants which will produce a variety of products including aluminum sulphate, lead oxide, fireproofing materials, helium, metallic phosphates, phosphorus, and sodium carbonate, according to advices from Rome.

United States exports of chemicals and allied products during October reached the highest value recorded for several years, according to an analysis of preliminary statistics by the Commerce Department. Every major item in the list, except sulphur, shared in the gain with notable increases being made in shipments of naval stores, coal-tar products, particularly benzol and dyes, and potash fertilizers.

The total value of chemical exports aggregated $13,570,000 in October, compared with $12,030,000 during the preceding month, and $10,301,000 for October last year, statistics show.

In point of value, fertilizer led the chemical export list during the month, with shipment amounting to 161,955 tons valued at $1,850,700, an increase in quantity of 26,367 tons and $422,100 in value compared with October last year. The increase was due largely to heavier shipments of potash materials, which increased from 1,769 to 9,596 tons and the value rose from $40,000 to $301,660, compared with October last year.

Shipments of coal-tar products were valued at $1,328,400, compared with $904,250 for the same month of last year. In this group benzol exports increased from 36,700 to 1,970,500 gal. and dyes, colors, stains, etc. doubled in quantity to 1,816,000 lb.

Total shipments of industrial chemicals and chemical specialties, which includes a long list of commodities were valued at $3,362,050, compared with $2,742,000 for October last year.

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This Month	**93.05**
Last month	92.20
December, 1934	83.32
December, 1933	51.89

Prices in the market for oils and fats showed a mixed trend. Crude cottonseed, corn, peanut, and oleo oils were higher with the paint-making oils lower. Tallow also sold off but the weighted influence was toward a higher general price level.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	**87.35**
Last month	87.20
December, 1934	88.01
December, 1933	87.45

Turpentine held an easy price position during the month but higher prices were quoted for bichromates, copperas, and different items in the coal-tar group. With few exceptions contract prices either are unchanged or are higher than a year ago.

Current PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Dec. 13.

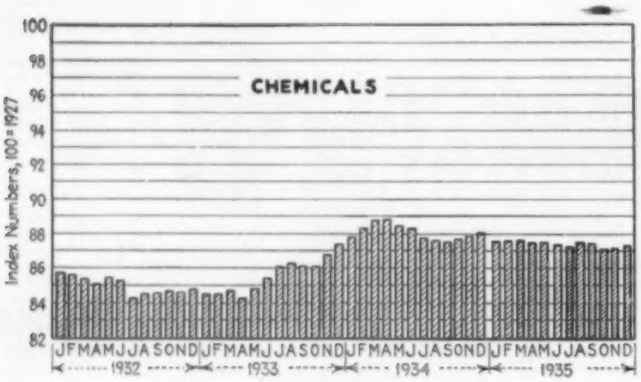
Industrial Chemicals

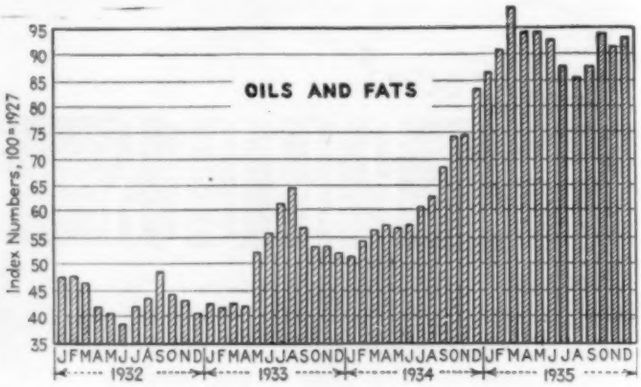
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.12 –$0.12½	$0.12 –$0.12½	$0.12 –$0.12½
Acid, acetic, 28%, bbl., cwt.	2.45 – 2.70	2.45 – 2.70	2.40 – 2.55
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	8.25 – 8.50
U. S. P. reagent	10.52 –10.77	10.52 –10.77	10.52 –10.77
Boric, bbl., ton	105.00–115.00	105.00–115.00	95.00 –105.00
Citric, kegs, lb.	.28 – .31	.28 – .31	.28 – .31
Formic, bbl., ton	.11 – .11½	.11 – .11½	.11 – .11½
Gallic, tech., bbl., lb.	.60 – .65	.60 – .65	.60 – .65
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Latic, 44%, tech., light, bbl., lb.	.12 – .12½	.12 – .12½	.12 – .12½
22%, tech., light, bbl., lb.	.06½– .07	.06½– .07	.06½– .07
Muriatic, 18°, tanks, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –	18.50 –20.00
Oxalic, crystals, bbl., lb.	.11½– .12¾	.11½– .12¾	.11½– .12¾
Phosphoric, tech., c'bys., lb.	.09 – .10	.09 – .10	.09 – .10
Sulphuric, 60°, tanks, ton	11.00 –11.50	11.00 –11.50	11.00 –11.50
Sulphuric, 66°, tanks, ton	15.50 –	15.50 –	15.50 –
Tannic, tech., bbl., lb.	.23 – .35	.23 – .35	.23 – .35
Tartaric, powd., bbl., lb.	.24 – .25	.24 – .25	.25 – .26
Tungstic, bbl., lb.	1.50 – 1.60	1.50 – 1.60	1.40 – 1.50
Alcohol, Amyl	–	–	–
From Pentane, tanks, lb.	.15 –	.15 –	.143–
Alcohol, Butyl, tanks, lb.	.12 –	.12 –	.12 –
Alcohol, Ethyl, 190 p'f., bbl., gal.	4.27½–	4.27½–	4.15½–
Denatured, 190 proof			
No. 1 special, dr., gal.	.36 –	.36 –	.346–
No. 5, 188 proof, dr., gal.	.35½–	.35½–	.34 –
Alum, ammonia, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Chrome, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Potash, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Aluminum sulphate, com., bags cwt.	1.35 – 1.50	1.35 – 1.50	1.35 – 1.50
Iron free, bg., cwt.	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Aqua ammonia, 26°, drums, lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Ammonia, anhydrous, cyl., lb.	.15½– .16	.15½– .16	.15½– .16
tanks, lb.	.04½–	.04½–	.04½–
Ammonium carbonate, powd. tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt.	1.20 –	1.20 –	1.20 –
Amylacetate tech., tanks, lb.	.142–	.142–	.142–
Antimony Oxide, bbl., lb.	.14 – .14½	.14 – .14½	.10½ – .10¾
Arsenic, white, powd., bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Red, powd., kegs, lb.	.15½– .16	.15½– .16	.15½– .16
Barium carbonate, bbl., ton	56.50 –58.00	56.50 –58.00	56.50 –58.00
Chloride, bbl., ton	72.00 –74.00	72.00 –74.00	74.00 –75.00
Nitrate, cask, lb.	.08½– .09	.08½– .09	.08½– .09
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt.	2.00 – 2.10	2.00 – 2.10	1.90 – 2.00
Borax, gran., bags, ton	44.00 –49.00	44.00 –49.00	40.00 –45.00
Bromine, cs., lb.	.36 – .38	.36 – .38	.36 – .38
Calcium acetate, bags	2.10 –	2.10 –	2.00 –
Arsenate, dr., lb.	.06 – .07	.06 – .07	.06 – .07
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	20.00 –33.00	20.00 –33.00	17.50 –
flake, dr., del., ton	22.00 –35.00	22.00 –35.00	19.50 –
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Tetrachloride drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Chlorine, liquid, tanks, wks., lb.	2.15 –	2.15 –	2.00–
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.39 – 1.45	1.39 – 1.45	1.25 – 1.30
Copperas, bgs., f.o.b., wks., ton	15.00 –16.00	14.00 –15.00	14.00 –15.00
Copper carbonate, bbl., lb.	.08½– .16	.08½– .16	.08½– .16
Cyanide, tech., bbl., lb.	.37 – .38	.37 – .38	.37 – .38
Sulphate, bbl., cwt.	3.85 – 4.00	3.85 – 4.00	3.85 – 4.00
Cream of tartar, bbl., lb.	.16½– .17	.16½– .17	.17½– .18
Diethylene glycol, dr., lb.	.16½– .20½	.16½– .20½	.14 – .16
Epsom salt, dom., tech., bbl., cwt.	2.10 – 2.15	2.10 – 2.15	2.10 – 2.15
Imp., tech., bags, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Ethyl acetate, drums, lb.	.08½–	.08½–	.08½–
Formaldehyde, 40%, bbl., lb.	.06 – .07	.06 – .07	.06 – .07
Furfural, dr., contact, lb.	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, crude, drums, gal.	.75 –	.75 –	.75 –
Refined, dr., gal.	1.25 – 1.30	1.25 – 1.30	1.25 – 1.30
Glaubers salt, bags, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Glycerine, c.p., drums, extra, lb.	.14 – .14½	.14 – .14½	.14 – .14½
Lead:			
White, basic carbonate, dry casks, lb.	.06½–	.06½–	.06½–
White, basic sulphate, sck., lb.	.06 –	.06 –	.06 –
Red, dry, sck., lb.	.07 –	.07 –	.06 –
Lead acetate, white crys., bbl., lb.	.10½– .11	.10½– .11	.10½– .11
Lead arsenate, powd., bbl., lb.	.09 – .10	.09 – .10	.09 – .10
Lime, chem., bulk, ton	8.50 –	8.50 –	8.50 –
Litharge, pwd., csk., lb.	.06 –	.06 –	.05 –
Lithophone, bags, lb.	.04½– .05	.04½– .05	.04½– .05
Magnesium carb., tech., bags, lb.	.06 – .06¼	.06 – .06¼	.06 – .06¼
Methanol, 95%, tanks, gal.	.33 –	.33 –	.33 –
97%, tanks, gal.	.34 –	.34 –	.34 –
Synthetic, tanks, gal.	.35½–	.35½–	.35½–
Nickel salt, double, bbl., lb.	13. – .13½	.13 – .13½	.11½– .12
Orange mineral, csk., lb.	.10 –	.10 –	.09 –
Phosphorus, red, cases, lb.	.44 – .45	.44 – .45	.44 – .45
Yellow, cases, lb.	.28 – .32	.28 – .32	.28 – .32
Potassium bichromate, casks, lb.	.08½– .09	.07½– .08½	.07½– .08½
Carbonate, 80-85%, calc. csk., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Chlorate, powd., lb.	.08½– .09	.08½– .09	.09½– .10
Hydroxide(c'stic potash) dr., lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Muriate, 80% bgs., ton	22.00 –	22.00 –	22.00 –
Nitrate, bbl., lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb.	.18 – .19	.18 – .19	.18 – .19
Sal ammoniac, white, casks, lb.	.04½– .05	.04½– .05	.04½– .05
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 –	1.23 –	1.23 –
Dense, bags, cwt.	1.25 –	1.25 –	1.25 –
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 – 3.00	2.60 – 3.00	2.60 – 3.00
Acetate, works, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl., cwt.	1.85 – 2.00	1.85 – 2.00	1.85 – 2.00
Bichromate, casks, lb.	.06½– .07	.05½– .06½	.05½– .06½
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	14.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06½	.06½– .06½	.06½– .06½
Chloride, tech., ton	12.00 –14.75	12.00 –14.75	12.00 –14.75
Cyanide, cases, dom., lb.	.15½– .16	.15½– .16	.15½– .16
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., lb.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	3.25 – 3.40	3.25 – 3.40	3.25 – 3.40
Nitrate, bags, cwt.	1.275–	1.275–	1.24 –
Nitrite, casks, lb.	.07½– .08	.07½– .08	.07½– .08
Phosphate, dibasic, bbl., lb.	.022– .023	.022– .023	.022– .024
Prussiate, yel. drums, lb.	.11½– .12	.11½– .12	.11½– .12
Silicate (40° dr.) wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60-62%, dr., lb.	.02½– .03½	.02½– .03	.02½– .03
Sulphite, cyrs., bbl., lb.	.02½– .02½	.02½– .02½	.02½– .02½
Sulphur, crude at mine, bulk, ton	18.00 –	18.00 –	18.00 –
Chloride, dr., lb.	.03½– .04	.03½– .04	.03½– .04
Dioxide, cyl, lb.	.07 – .07½	.07 – .07½	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb.	.54 –	.54 –	.56 –
Crystals, bbl., lb.	.37½–	.38½–	.38 –
Zinc chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05½– .06
Carbonate, bbl., lb.	.09 – .11	.09 – .11	.09½– .11
Cyanide, dr., lb.	.36 – .38	.36 – .38	.38 – .42
Dust, bbl., lb.	.069– .07	.069– .07	.059– .07
Zinc oxide, lead free, bag, lb.	.05 –	.05 –	.06½–
5% lead sulphate, bags, lb.	.04½–	.04½–	.06½–
Sulphate, bbl., cwt.	2.65 – 3.00	2.65 – 3.00	2.75 – 3.00

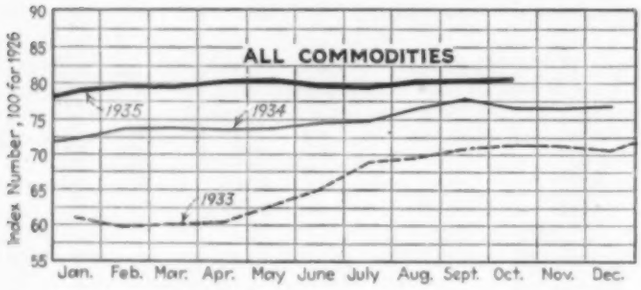
Oils and Fats

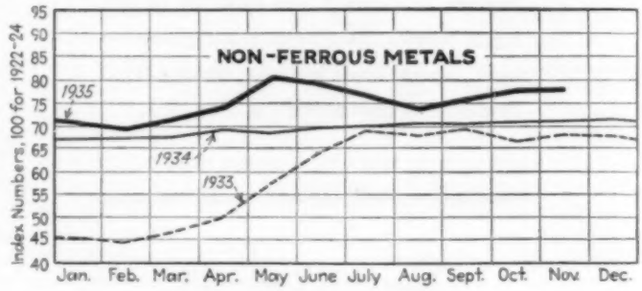
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.10 –$0.11	$0.10 –$0.11	$0.09½–$0.10
Chinawood oil, bbl., lb.	.16½–	.19 –	.09 –
Coconut oil, Ceylon, tanks, N. Y. lb.	.04½–	.04½–	.03½–
Corn oil crude, tanks, (f.o.b mill), lb.	.10½–	.09½–	.09½–
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.09½–	.08½–	.09 –
Linseed oil, raw car lots, bbl., lb.	.095–	.097–	.087–
Palm, casks, lb.	.04¾–	.04¾–	.04½–
Palm kernel, bbl., lb.	.05½–	.05½–	.03½–
Peanut oil, crude, tanks (mill), lb.	.09½–	.09½–	.09½–
Rapeseed oil, refined, bbl., gal.	.54 – .55	.52 – .53	.40 – .41
Soya bean, tank, lb.	.09 –	.09 –	.07½–
Sulphur (olive foots), bbl., lb.	.09 –	.09¾–	.07½–
Cod, Newfoundland, bbl., gal.	.35 –	.35 –	.38 –
Menhaden, light pressed, bbl., lb	.072–	.072–	.046–
Crude, tanks (f.o.b. factory), gal.	.32 –	.32 –	.20 –
Grease, yellow, loose, lb.	.06 –	.06½–	.04½–
Oleo stearine, lb.	.11½–	.11½–	.08½–
Red oil, distilled, d.p. bbl., lb.	.09½–	.09½–	.07 –
Tallow, extra, loose, lb.	.06½–	.07½–	.05½–

CHEM. & MET.'S WEIGHTED PRICE INDEXES









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 –$0.65	$0.60 –$0.65	$0.60 –$0.62
Refined, bbl., lb.	.80 – .85	.80 – .85	.80 – .85
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.14½– .15	.14½– .15	.14½– .15
Aniline salts, bbl., lb.	.24 – .25	.24 – .25	.24 – .52
Benzaldehyde, U.S.P., dr., lb.	1.10 – 1.25	1.10 – 1.25	1.10 – 1.25
Benzidine base, bbl, lb.	.65 – .67	.65 – .67	.65 – .67
Benzoic acid, U.S.P., kgs., lb.	.48 – .52	.48 – .52	.48 – .52
Benzyl chloride, tech., dr., lb.	.30 – .35	.30 – .35	.30 – .35
Benzol, 90%, tanks, works, gal.	.18 – .20	.18 – .20	.19 – .20
Beta-naphthol, tech., drums, lb.	.24 – .27	.22 – .24	.22 – .24
Cresol, U.S.P., dr., lb.	.11 – .11½	.11 – .11½	.11 – .11½
Cresylic acid, 97%, dr., wks., gal.	.45 – .46	.45 – .46	.50 – .51
Diethylaniline, dr., lb.	.55 – .58	.55 – .58	.55 – .58
Dinitrophenol, bbl., lb.	.29 – .30	.29 – .30	.29 – .30
Dinitrotoluen, bbl., lb.	.16 – .17	.16 – .17	.16 – .17
Dip oil, 25%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb.	.38 – .40	.38 – .40	.38 – .40
H-acid, bbl., lb.	.65 – .70	.65 – .70	.65 – .70
Naphthalene, flake, bbl., lb.	.07 – .07½	.07 – .07½	.06 – .07
Nitrobenzene, dr., lb.	.08½– .09	.08½– .09	.08½– .10
Para-nitraniline, bbl., lb.	.51 – .55	.51 – .55	.51 – .55
Phenol, U.S.P., drums, lb.	.14½– .15	.14½– .15	.14½– .15
Picric acid, bbl., lb.	.30 – .40	.30 – .40	.30 – .40
Pyridine, dr., gal.	1.10 – 1.15	1.10 – 1.15	1.10 – 1.15
Resorcinal, tech., kegs, lb.	.65 – .70	.65 – .70	.65 – .70
Salicylic acid, tech., bbl., lb.	.40 – .42	.40 – .42	.40 – .42
Solvent naphtha, w.w., tanks, gal.	.26 –.....	.26 –.....	.26 –.....
Toluidine, bbl., lb.	.88 – .90	.88 – .90	.88 – .90
Toluene, tanks, works, gal.	.30 –.....	.30 –.....	.30 –.....
Xylene, com., tanks, gal.	.30 –.....	.30 –.....	.26 –.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grid., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.15 – .16	.14 – .15	09½– .10
China clay, dom., f.o.b. mine, ton	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 – .20	.04 – .20	.04 – .20
Prussian blue, bbl., lb.	.36½– .38	.36½– .38	.35½– .37
Ultramarine blue, bbl., lb.	.06 – .32	.06 – .32	.06 – .32
Chrome green, bbl., lb.	.26 – .27	.26 – .27	.26 – .27
Carmine red, tins, lb.	4.00 – 4.40	4.00 – 4.40	4.00 – 4.40
Para toner, lb.	.80 – .85	.80 – .85	.80 – .85
Vermilion, English, bbl., lb.	1.58 – 1.60	1.52 – 1.55	1.56 – 1.60
Chrome yellow, C. P., bbl., lb.	.14 – .16	.14 – .16	.15 – .15½
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 – .08½	.07 – .08½	.07 – .08½
Gum copal Congo, bags, lb.	.09 – .10	.09 – .10	.06 – .08
Manila, bags, lb.	.09 – .10	.09 – .10	.16 – .17
Damar, Batavia, cases, lb.	.15½– .16	.15½– .16	.16 – .16½
Kauri No. 1 cases, lb.	.20 – .25	.20 – .25	.45 – .48
Kieselguhr (f.o.b. N. Y.), ton.	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton.	50.00 –.....	50.00 –.....	40.00 –.....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl.	5.50 –.....	5.90 –.....	5.75 –.....
Turpentine, gal.	.49 –.....	.51 –.....	.53 –.....
Shellac, orange, fine, bags, lb.	.28 –.....	.28 –.....	.35 –.....
Bleached, bonedry, bags, lb.	.24 –.....	.24 –	.30 –.....
T. N. bags, lb.	.16 –.....	.16 –	.23 –.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 –10.00	7.50 –10.00	7.50 –11.00
325 mesh (f.o.b. N. Y.), ton.	13.75 –.....	13.75 –.....	13.75 –.....

INDUSTRIAL NOTES

THE FOXBORO CO., Foxboro, Mass., announces that Robert E. Rogers, Jr. has joined the engineering sales staff of the New York office after a sojourn of a year and a half as instrument and process engineer for refineries in the Netherlands West Indies.

STRUTHERS-WELLS CO., Warren, Pa., has moved its New York offices to 30 Rockefeller Plaza.

LINK-BELT CO., has moved its executive offices to the Bell Bldg., 307 N. Michigan Ave., Chicago.

REPUBLIC STEEL CORP., Youngstown, Ohio, has appointed Paul R. Johnston, district sales manager in the Cincinnati territory to succeed Robert J. Working who, in turn, has taken the place of K. D. Mann as district sales manager at Birmingham, Ala.

ROLLER-SMITH CO., New York, has appointed Harris-Green Co., Farmers Bank Bldg., Pittsburgh, as sales agent for Western Pennsylvania, Eastern Ohio, and West Virginia.

AUTOMATIC TEMPERATURE CONTROL CO., Philadelphia, has added as representatives, Stewart N. Miller, 179 Melrose Ave., Needham, Mass., and Fred I. Tourtelot Co., 20 E. Jackson Blvd., Chicago.

THE KENNEDY VALVE MFG. CO., Elmira, N. Y., is now represented in the lower peninsula of Michigan by Frank DeWitt & Co., 5736 Twelfth St., Detroit.

PAUL O. ABBÉ INC., Little Falls, N. J., has opened an office at 407 S. Dearborn St., Chicago.

THE LINCOLN ELECTRIC CO., Cleveland, has opened an office at Peoria, Ill., with W. I. Miskoe in charge and at Memphis, Tenn., with O. B. Farrell in charge.

THE ORVILLE SIMPSON CO., Cincinnati, has appointed Brown & Sites Co., Inc., exclusive sales agents for Rotex screeners in the New York territory with headquarters at 30 Church St., New York.

THE METAL SPRAY CO., Los Angeles, Calif., has been succeeded by the Metalspray Co., Inc. J. C. Martin, Jr., has been elected president and H. B. Rice, vice-president.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1935	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	$964,000	$427,000
Middle Atlantic	$58,000	$68,000	3,288,000	3,491,000
South	2,908,000	100,000	12,216,000	6,059,000
Middle West	240,000	1,477,000	12,360,000	10,526,000
West of Mississippi	255,000	101,000	7,273,000	7,191,000
Far West	746,000	125,000	5,977,000	6,388,000
Canada	228,000	35,000	13,251,000	1,778,000
Total	$4,435,000	$1,906,000	$53,329,000	$35,860,000

PROPOSED WORK
BIDS ASKED

Alcohol Plant—Agricultural Power Alcohol Corp., Phillip A. Tomek, David City, Neb., Pres., 4th and Pierce Sts., Omaha, Neb., has acquired the Iler Distillery at the above address and will improve same and install machinery for the manufacture of alcohol out of farm products to be blended with gasoline as an automotive fuel; commercial alcohol will also be produced. Estimated cost for building improvements $20,000, for machinery, including stills, boilers, fermenters, agers and storage facilities, $80,000.

Cellophane Plant—Canadian Industries, Ltd., 1050 Beaver Hall Hill, Montreal, Que., Can., will call for bids next spring for the construction of an extension to its cellophane plant at Shawninigan Falls, Que. Estimated cost $100,000.

Cement Plant—San Antonio Portland Cement Co., c/o C. Baumberger, Jr., Pres., San Antonio, Tex., is having preliminary surveys made for the construction of a cement manufacturing unit to manufacture a cement particularly adapted for oil well casings. This will require some special and regular machinery and equipment. Maturity in 1936. Estimated cost $150,000.

Cement Plant—Yosemite Portland Cement Co., Merced, Calif., contemplates repairs and alterations to its cement plant. Estimated cost $60,000.

Diatomite Plant—Western Non-Metallics, Ltd., Burnaby, B. C., Can., plans the construction of a plant for the manufacture of diatomite.

Distillery — Belle of Anderson County Distillery Co., c/o D. B. Lodge, Lexington, Ky., has acquired a plant at Lexington and will recondition same for a distillery. Estimated cost $80,000.

Distillery—Glencoe Distillery, Louisville, Ky., plans extensions and improvements to its distilling plant. Estimated cost $30,000.

Distillery — Glenmore Distillery, Owensboro, Ky., plans extensions and improvements to its distilling plant. Estimated cost $30,000.

Distillery—National Distillers Products Corp., 120 Bway., New York, and Frankfort, Ky., plans to recondition and construct additions to old plant of E. H. Taylor Co. here for its own use. Sanderson & Porter, 52 William St., New York, N. Y., Engrs. Estimated cost $500,000.

Distillery—St. Lawrence Distilling Co., Heger Brewery Bldg., Jefferson, Wis., has acquired the plant of the Heger Brewing Co. and will convert same into a distillery. Estimated cost $30,000.

Distillery—Seagram Distillery Co., Louisville, Ky., will soon award the contract for the construction of units 1 and 2 for its proposed new distillery to be built on a 45-acre tract just outside the city limits on 18th St. Rd. Joseph & Joseph, Breslin Bldg., Louisville, Archts. Estimated cost $2,000,000 or more.

Factory — Colgate-Palmolive-Peet Co., 105 Hudson St., Jersey City, N. J., plans to alter its factory at 39 Sussex St., Jersey City. Estimated cost $30,000.

Gas Plant—Board of Public Works, Mt. Vernon, Ind., has had plans prepared by D. T. Blakey, Engr., Acme Hotel, Evansville, for the construction of a 1 story gas plant to include a 14,000 gal. steel liquid storage tank and an 18,000 cu.ft. steel gas storage tank, also gas compressors, gas control and equipment and approximately 5 mi. standard metal piping for distribution system. H. Bray, Mayor. Estimated cost $60,000.

Plant—Westinghouse Electric & Manufacturing Co. has purchased the plant of the Mansfield Vitrous Enameling Co., at Mansfield, O., and will improve same. Estimated cost $100,000.

Laboratory—State Hy. Comn., Carson City, Nev., will construct a materials and research laboratory building, including equipment. R. A. Allen, State Hy. Engr. Estimated cost $30,000.

Laboratory—General Aniline Co., Rensselaer, N. Y., A. March, Bldg. Mgr., plans to construct an addition to its laboratory. Estimated cost including equipment $28,000.

Paper Pulp Plant — St. Regis Kraft Co., W. W. Griffith, Mgr., Tide Flats, Tacoma, Wash., plans to reopen its plant and convert same into a bleached paper plant.

Cracking Plant—Central Refiners, Ltd., 147 10th St., Brandon, Man., Can., plans the construction of a cracking plant. Estimated cost $100,000.

Refinery—Wood-Moore Co., Tulsa, Okla., has purchased a site at Port Lavaca, Tex., and plans to construct a small refinery. Estimated cost $25,000.

Polymerization Plant—Standard Oil Co. of California, 225 Bush St., San Francisco, Calif., will have plans prepared by its own engineering department for the construction of a polymerization plant to produce a fuel element to raise the power of aviation gasoline. Estimated cost $600,000.

Rubber Factory—Corduroy Rubber Co., Fuller St. N.E., Grand Rapids, Mich., will soon award the contract for the construction of a rubber factory. N. Westra, 110 Michigan Trust Bldg., Grand Rapids, Archt. Estimated cost $50,000.

Tannery—William Flaccus Tanning Co., Edward Flaccus, Mgr., Buchanon, W. Va., plans to rebuild its tannery recently destroyed by fire.

Warehouse — American Distilling Co., c/o W. E. Murray, Engr., 908 Hayes St., San Francisco, Calif., is having plans prepared for the construction of a 160x200 ft. rein.-con., brick and tile warehouse at Sausalito, Calif.

Warehouse—James E. Pepper Distillery, Lexington, Ky., plans the construction of a bonded warehouse. Carl J. Kiefer, Schmidt Bldg., Cincinnati, O., Archt. and Engr. Estimated cost $200,000.

Warehouses—K. Taylor Distilling Co., Frankfort, Ky., plans to construct two warehouses to have capacity of 30,000 bbl. each. Estimated cost $40,000.

CONTRACTS AWARDED

Cement Plant—Louisville Cement Co., Speed Bldg., Louisville, Ky., will build an addition to its cement plant. Separate contracts have been awarded for the work. Structural steel contract to McClintic-Marshall Co., Bethlehem, Pa. Estimated cost $50,000.

Chemical Plant—Industrial Chemical Products Co., 3777 Bellevue Ave., Detroit, Mich., has awarded the contract for an addition to its plant to Wasmund Construction Co., c/o Owner. Estimated cost $50,000.

Chemical Plant—Thompson-Hayward Chemical Co., 2915 Southwest Blvd., Kansas City, Mo., awarded contract for addition to plant to Flett Building & Repair Co., 4037 Virginia St., Kansas City. Estimated cost $50,000.

Chlorine Plant—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., awarded contract for new addition to Columbia Chemical Division at Barberton, O., to be used for the manufacture of chlorine, to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $1,250,000.

Factory—Ditzler Color Co., 800 West Chicago Ave., Detroit, Mich., awarded contract for addition to plant to Banbrook-Gowan Co., 4849 Woodward Ave., Detroit, Mich. Estimated cost $60,000.

Factory—Oldbury-Electro-Chemical Co., Buffalo Ave., Niagara Falls, N. Y., awarded contract for 62x84 ft. factory to Wright & Kremers, Inc., Main and Pine Sts., Niagara Falls.

Factory — Universal Gypsum & Lime Co., 420 Lexington Ave., New York, N. Y., will improve its factory at York, Pa. Work will be done by day labor and separate contracts. Estimated cost $40,000.

Factory—Universal Gypsum & Lime Co., 420 Lexington Ave., New York, N. Y., will improve its factory at Ft. Dodge, Ia. Work will be done by day labor and separate contracts. Estimated cost $35,000.

Gas Plant—City, Webster City, Ia., awarded contract for gas plant improvements, incl. 50,000 cu.ft. gas holder, new booster, new master meter and new roof over present plant, to Koppers Construction Co., Fort Wayne, $36,388.

Gas Plant—Puritan Compressed Gas Co., 2012 Grand Ave., Kansas City, Mo., awarded contract for addition to plant to Miller-Stauch Construction Co., Railway Exchange Bldg., Kansas City. Estimated cost $30,000.

Glass Factory—Hazel-Atlas Glass Co. of California, Ltd., 89th Ave. and G Sts., Oakland, Calif., awarded contract for factory addition to Larsen & Larsen, 629 Bryant St., San Francisco. Estimated cost including equipment $125,000.

Rayon Plant — DuPont Rayon Co., Amphill (near Richmond), Va., will construct an addition to its plant. Work will be done by day labor and separate contracts. Estimated cost $50,000.

Rubber Factory—Joseph Stokes Rubber Co., John St., Welland, Ont., Can., awarded contract for 2 story addition to factory to R. Timms, 221 Burgar St., Welland. Estimated cost $35,000.

Storage Building — Hazel Atlas Glass Co., Wheeling, W. Va., awarded contract for storage and distribution building at Zanesville, O., to Dunsweiler Construction Co., Zanesville, O. Estimated cost $100,000.

Gas Holder—Diamond Alkali Co., Fairport, O., awarded contract for gas holder to have a capacity of 200,000 cu.ft. to McClintic-Marshall Co., Bethlehem, Pa.

STRONG MARKETS FOR NAPHTHALENE HERE AND IN UNITED KINGDOM

RECENT advances in sales prices for naphthalene have directed attention to the firm position of that commodity. The new schedule for round lots represented an increase of 1¼c. per lb. For the eastern section of the country the wholesale price schedule is—chipped or crushed, barrels or bags, 6c. per lb.; rice (crystals) or powdered, barrels, 7c. per lb. Ball and flakes, 16-ounce packages (48 to the case), 7½c. per lb.; 12-ounce packages (72 to the case), 6c. per package; barrels, 6¾c. per lb. and 50-pound cases, 7c. per lb. Western prices are ½c. per lb, and, in connection with 12-ounce packages, ½c. per package higher. Store door delivery in Metropolitan Philadelphia, New York and City of Chicago will be made to wholesalers in minimum lots of 2,000 lb. Smaller shipments will be assessed a delivery charge of 30c. per 100 lb. The latter is an innovation in the price schedule for naphthalene.

Domestic Consumption Increases

United States consumption of naphthalene has increased rapidly in recent years due to the ever widening use of this product in industry, according to a recent report from the Commerce Department's Chemical Division.

Production of naphthalene increased from 15,000,000 lb. of refined and flake, and 8,400,000 lb. of crude and refined in 1924 to 38,750,000 and 37,900,000 lb., respectively, in 1934, and in spite of this increase in domestic production imports over the same period advanced from 5,266,700 to 47,995,000 lb. of crude naphthalene.

In reporting on production for 1933 the U. S. Tariff Commission listed seven domestic companies as producers in that year of naphthalene solidifying 79 deg. C. or above (refined, flake). While domestic output for 1933 was reported at 42,707,648 lb., the quantity actually sold was given as 28,658,301 lb. with a sales value of $1,065,044 which represents an average value of 3.7 cents per pound which is considerably below the figure which has been quoted for deliveries for the coming year.

Domestic production figures for 1935 are not yet available but imports during the first three quarters of 1935 totaling 35,506,000 lb. were almost identical with receipts for the first nine months of last year.

Naphthalene, a coal-tar derivative, has many uses in industry, some of which are in the manufacture of dyes, insecticides and disinfectants, explosives, moth balls, laboratory reagents, and most important of all, perhaps, in the production of phthalic acid and anhydride, a large part of which is used in manufacturing synthetic resins for use in the paint and varnish and other industries.

A new process of making phthalic acid from naphthalene was discovered in 1916 following which production increased rapidly from less than 150,000 lb. per annum to 9,000,000 lb. in 1929. After declining for a period production again advanced sharply to 14,000,000 lb. in 1933, and in the year following, the last for which figures are available, to 20,680,000 lb.

In 1917 the cost of this product averaged $4.23 per lb., but as production increased the cost declined until the factory sales price averaged 12c. per lb. for the year 1934.

United Kingdom Market

In commenting on the situation in the United Kingdom, *The Chemical Trade Journal of London* said:

"With the incidence of the seasonal demand for firelighter-grade crude, the naphthalene market usually becomes firmer at the beginning of the winter. This year, however, the firmness is more than ordinarily accentuated; supplies are short, and prices for all grades are higher than they have been for several years past. Whizzed 77-78° C. material is becoming more and more difficult to secure in all districts, and its quoted price of £6 per ton is a purely nominal one, whilst available parcels of the refined grades are readily changing hands at anything up to £15 the ton. Buyers who have followed the market cannot be altogether surprised at current developments, for the comparative shortage of supplies has been evident throughout the summer months, whilst it was fairly obvious that, in any event, naphthalene values were likely to move in sympathy with the improved price position of creosotes and tar acids.

"No reliable figures on naphthalene production in the United Kingdom have been made generally available since those obtained in the 1930 Production Census, when the output, in terms of crude naphthalene, was 463,000 tons. For 1924, the immediately preceding Census year, the comparable output was 326,600 tons. Current production—or, should we say, potential production—is probably somewhat higher than in 1930. Imports, mainly refined naphthalene from Belgium, have never been large—between 10,000 and 20,000 tons a year—though statistics later than those for 1933 are yet lacking. Exports are on a more extensive scale, averaging 100,000 tons a year, and largely to the U.S.A., though here again the abnormally high figure of 131,413 tons for 1933 is the latest official one we have at hand. It is improbable, though, that the export of larger quantities of naphthalene from this country to the U.S.A. is responsible for the existing shortage of supplies on the home market, for America is finding it so difficult to draw upon European naphthalene for even its normal import needs that the schedule of prices for refined naphthalene delivery to U.S. consumers next year has been marked up fairly steeply, whilst American buyers are seeking to cover their needs by taking parcels from such unusual sources as the Irish Free State.

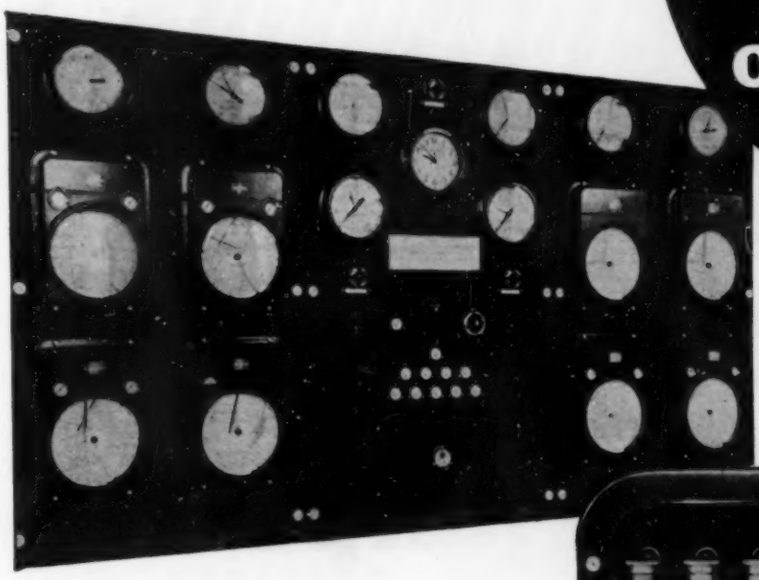
Disturbing Factors

"Several factors, it is safe to assume, have been responsible for disturbing the balance between supply and demand in the naphthalene market in this country, but two of these factors are probably the dominating ones. The utilization of the product in the chemical industries is a steadily growing one. Apart from its long-established uses in the dyestuffs and pharmaceutical industries, ever-increasing tonnages of naphthalene are being catalytically oxidized to phthalic anhydride, the anhydride being later worked up into indigoid or anthraquinonoid vat dyestuffs, alizarin or allied mordant dyestuffs, or into lacquers and resins of the alkyd group. Further, the hydrogenated and chlorinated naphthalenes are acquiring consistently increasing importance for various purposes, and this again is reflected in an extended call for the raw material. The second factor referred to above is, however, of more recent import—namely, the use of creosote oils containing a high percentage of naphthalene for hydrogenation into motor spirit.

"Whether the presence of the naphthalene renders the creosote easier of hydrogenation by the Billingham pressure process, or whether it is simply a question of economics, we are of course unable to say, although the fact that the heavy oils from low-temperature tar are successfully used is a pointer in the latter direction. But it has obviously paid tar distillers to market their naphthalene-rich creosotes rather than to extract the naphthalene. Continuance of the price appreciation for naphthalene may put an entirely different complexion on the matter, though even then the probability that increased naphthalene supplies may occasion a relapse in values will be recognized."

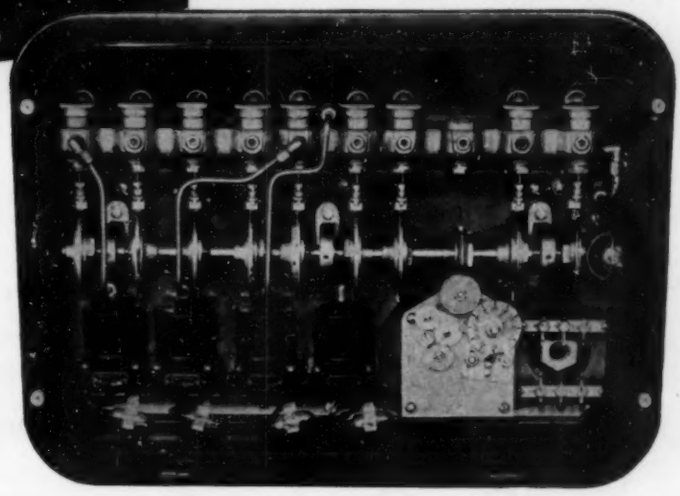
Now *recover Solvent Vapors more profitably with*

COLUMBIA ACTIVATED CARBON in Automatically Operated Equipment



Left—Panel with the instruments which operate and control one of the new Automatic Solvent Recovery Plants. Signal lights indicate the operations being performed. Gauges, meters, and thermometers control, indicate and record pressures, rates of flow and temperatures.

Below—The "mechanical brain" of the unit, open for inspection. This is located in the black box at the bottom center of the panel. The motor-driven camshaft automatically operates the plant on a predetermined cycle.



SOLVENT recovery plants designed and installed by Carbide and Carbon Chemicals Corporation profitably recover a large number of vaporized solvents. COLUMBIA ACTIVATED CARBON* effects high recovery and special engineering features of the equipment insure easy, safe, economical operation.

Now, with the development by Carbide and Carbon Chemicals Corporation of fully automatic process operation and control, the recovery of solvent vapors becomes even more profitable. Data from plants installed show that this new feature reduces labor requirements and insures most economical use of power, steam and water. A total operating cost of 2c per gallon of recovered solvent, with recoveries as high as 94%, is not unusual. The lowest priced solvents can thus be recovered profitably.

Our engineers will gladly inspect manufacturing operations where solvents are vaporized to determine the savings that can be secured through solvent recovery. They are prepared to design and install complete recovery equipment suitable for your needs and to give a definite guarantee of its performance. Write for description of an actual installation of the new automatic recovery system or, if you wish, request a survey.

Activated Carbon Division
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Unit of Union Carbide and Carbon Corporation
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30 East 42nd Street, New York, N. Y.

*U. S. Patents 1,497,543; 1,497,544 and others

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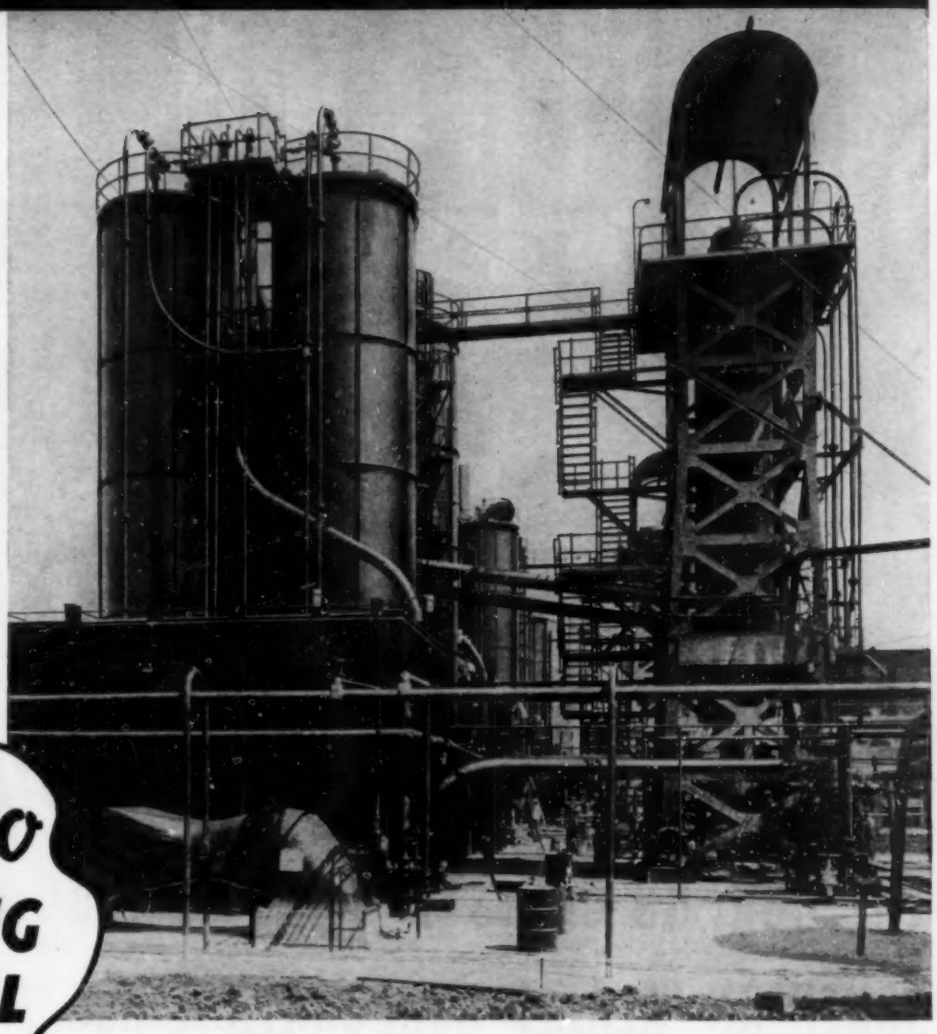

... *to* REFINING SALAD OIL

PETROLEUM from well to consumer requires a number of chemicals. One of these is P. Q. Silicate of Soda. For instance, for steel cracking chambers, a lining, resistant to acid and corrosion, uses P. Q. Silicate as the binder.

Another problem in the petroleum industry was solved by using P. Q. Silicate to hasten and improve separation between solid paraffin wax and liquid mineral oil. Dirty crank case oil and dry cleaners' solvents are economically restored to usefulness by clarifying with the right silicates.

Animal, vegetable and high viscosity mineral oils are shipped in wooden containers, silicate treated to prevent absorption and leakage.

Getting down to the salad bowl, we trace the long established use of "N" Brand, Silicate of Soda as an ingredient in the vegetable oil refining process to permit higher recovery with less free fatty acid.

Have you a problem involving an oil? Maybe a P. Q. Silicate can help you.

Oil Problems solved with P. Q. Silicates:

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Alkali consumers located in the Southwest and along the Atlantic and Pacific coasts have learned from experience that they can depend upon the Corpus Christi plant of the Southern Alkali Corporation for prompt delivery of alkali products with definite standards of quality, uniformity and purity. Added to quality and dependability this plant offers alkali users:

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A Technical Service Department—*to help solve production and handling problems of alkali buyers.*

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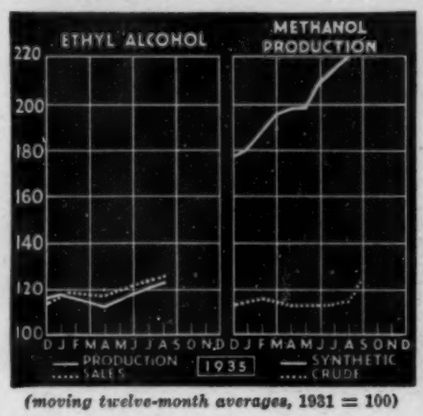
SOLVENT NEWS

Reg. U. S. Pat. Off.

DECEMBER ★ A Monthly Series of Articles for Chemists and Executives of the Solvent-Consuming Industries ★ 1935



(moving twelve-month averages, 1931 = 100)

		1935	1934
ETHYL ALCOHOL			
Production			
1000 proof gals.	Jan.-Sept.	132,508	122,247
	September	19,607	15,636
	August	16,646	13,823
Sales			
1000 proof gals.	Jan.-Sept.	129,171	109,947
	September	19,807	17,821
	August	16,576	13,156
METHANOL			
Crude Production			
1000 gals.	Jan.-Sept.	3,181	2,800
	September	369	260
	August	382	254
Synthetic Production			
1000 gals.	Jan.-Sept.	11,510	8,134
	September	1,540	1,080
	August	1,390	952

SOLVENT WITHDRAWALS STEADY

Withdrawals of solvents by large consumers continued steady during November, reflecting the activity in these industries which has been well maintained.

September sales reported by the paint, varnish and lacquer industry were nearly seven million dollars above the total for the corresponding month of 1934. Automobile production for November is estimated at close to 250,000 units, reflecting the encouraging reception accorded new models. Both shipments and unfilled orders for pyroxylin-coated textiles were larger during September than the August figures according to the monthly report of the Department of Commerce.

INTRODUCTION OF STREAMLINED TRAINS WIDENS MARKET FOR LACQUER FINISHES

"Styling"—Keynote of Modern Trend in Railway Painting —Is Also Being Extended to Standard Equipment

The streamlined train, one answer of the railroad industry to the challenge of competition, marks a new era in railway equipment construction, and is leading to greatly increased use of nitrocellulose lacquers in a field which has heretofore relied chiefly on oil paints, enamels and varnishes.

Faced with the imperative demand for reduced costs and more efficient operation, the railroads have turned to the use of light-weight, Diesel-powered trains, and, in an effort to attract passenger traffic, have added streamlining. Success in reducing operating expenses seems assured, but also of great importance is the gain in passenger traffic which, in some cases, has exceeded even the most optimistic expectations. This is attributed to increased speeds and modern conveniences plus public acceptance of the principles of aerodynamic design and the use of smart decorative colors which have attracted such wide and favorable publicity.

Larger Use for Lacquers

It is the latter point, the choice of color and finishing materials, which merits special attention of the lacquer manufacturer. It is evident that "styling" is the keynote of the new streamlined train design. But of more importance is the application of styling with its use of bright, smart colors to standard equipment. This not only marks a definite departure from standard practice, but also greatly increases the scope of the potential market for lacquer finishes.

Railroad painting as applied to rolling stock may be divided into two classifications: exteriors and interiors. Rehabilitation and modernization of equipment now in use must also be considered as an additional classification; for, although the percentage of obsolescence is extremely high, many roads find it impracticable to make extensive purchases of new equipment at the present time.

Finishing Exteriors

In exterior finishing, problems of corrosion and abrasion resistance, and the necessity for the coating to withstand frequent cleanings, have been intensified by increased speeds and the use of lighter and brighter colors.

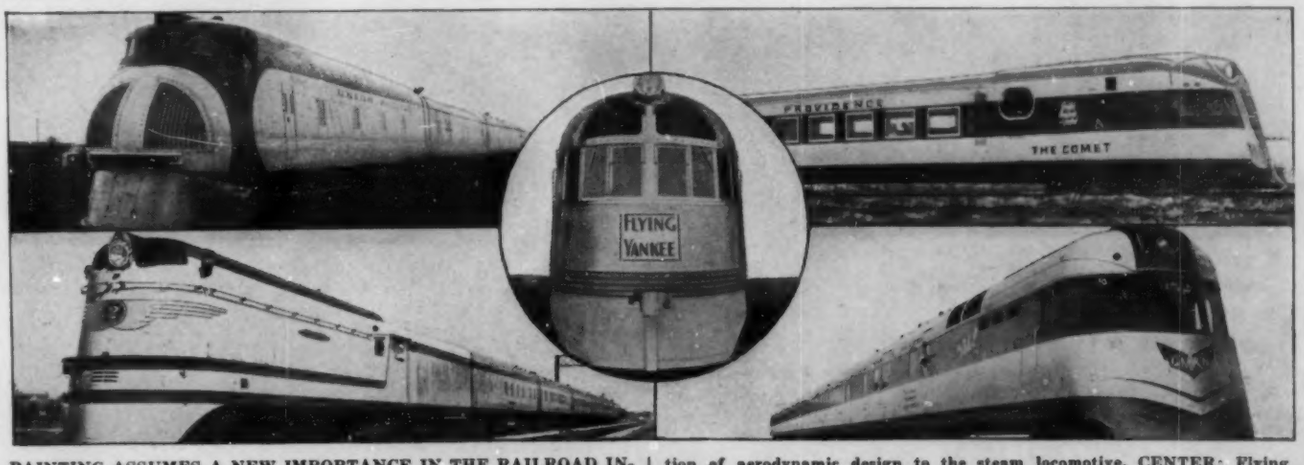
In the past, lacquer finishes have not been widely used, because states one authority, "Lacquer which gives remarkable service on automobiles in our experience, chips off in spots on corner posts, vestibule ends, rivets and projecting parts subjected to more severe contact with road ballast. Lettering and decorations wear off somewhat rapidly and these conditions introduce a maintenance difficulty."

Now, however, with streamlining and welded construction, train exteriors are relatively smooth; and the improvement in lacquers over the past few years in regard to filling power, elasticity, adhesion and light-fastness, has made this type of coating suitable and highly desirable for the strict requirements of metal finishing.

Colors Serve Dual Purpose

Brighter colors have been employed for the definite purpose of greater visibility (a safety measure), and to emphasize the streamline design. An outstanding example of the use of colors to produce a smart appearance is the *Hiawatha*, streamlined steam train of

(Continued on next page)



PAINTING ASSUMES A NEW IMPORTANCE IN THE RAILROAD INDUSTRY. The effects of "styling" and the smart use of color illustrates the influence of the professional industrial designer. Shown above are—UPPER LEFT: The M10001 of the Union Pacific finished in Canary Yellow and brown. LOWER LEFT: The streamlined Hiawatha, showing the application of aerodynamic design to the steam locomotive. CENTER: Flying Yankee, the Boston & Maine's contribution to the new trend of railway design, has a stainless steel exterior and uses lacquer for interior finish. UPPER RIGHT: The Comet—aluminum and bright blue; and, LOWER RIGHT: The Rebel—aluminum and Chinese Red.

Prepared Monthly by the U. S. Industrial Chemical Co., Inc.

ADVERTISEMENT—*This entire page is a paid advertisement.*

CHLORINATED RUBBER PAINTS OF U. S. MANUFACTURE AVAILABLE

During the past year several domestic manufacturers have announced the production of chlorinated rubber finishes.

Among these various coatings utilizing the protective and corrosion-resistant qualities of chlorinated rubber are: a general metal primer of reddish-brown color; acid and alkali resistant paints (in several colors); a gray colored concrete surface coat; and a special clear "lining material" for use as a finish over other chlorinated rubber paints where additional protection is desired.

LACQUERS FOR RAILROAD PAINTING

(Continued from preceding page)

the Chicago, Milwaukee, St. Paul & Pacific. The finish includes black, gray, orange-yellow, maroon and brown with lettering in gold leaf and the conventional Indian headdress in polished chromium. The *Comet*, New York, New Haven & Hartford's streamliner, is an aluminum train, finished in wide bands of blue and natural burnished aluminum protected by two coats of clear varnish. The *Rebel* of the Gulf, Mobile & Northern is finished with an aluminum paint (over an alloy steel), and a bright Chinese Red band extending the entire length of the train with a narrow gray stripe along the skirting at the bottom.

Interiors "Go Modern"

Car interior finishing practice is also undergoing marked changes. With the installation of air-conditioning equipment, accumulations of dirt and soot and the attendant need for frequent cleanings have been greatly reduced, leaving selection of coating materials almost entirely dependent on the single factor of resistance to normal wear. For this purpose, the lacquer type finish, with its wide range of colors, ease of application, and other advantages, is readily adaptable.

Choice of colors for interiors has also changed with the introduction of new trains, particular emphasis being placed on harmony of design. Pastel shades are popular and selection has been made to harmonize with upholstery, carpeting, etc. The *Rebel* is an excellent illustration of the new trend and shows the radical departure that has been made from "standardization." Each of the three regular cars and the "swing" coach is finished in a different color scheme. The buffet passenger coach has an ivory colored ceiling and two tones of pastel green on the sides. The sleeper-observation car has an ivory ceiling with the sides in pastel gray and gray-green. The observation room continues the ivory ceiling with the side walls finished in sand and mocha and the "swing" coach is finished with cream and mocha side walls and an ivory ceiling.

Styling On Standard Equipment

While the above is concerned primarily with streamlined trains, attention should be directed to the application of the same trend in finishing standard equipment. New trains of the Baltimore & Ohio and new coaches recently purchased by the Boston & Maine and the New Haven, all show similar styling in the use of smart colors.

Much has also been accomplished by the paint shops of the railroads, which have sought to capitalize on the popularity of the new designs by refinishing and modernization of present equipment. New decorative finishes have been added to both exteriors and interiors and have greatly improved the appearance over the drab finish of standard colors. And here again the use of lacquers offers an advantage—shorter drying time, an unimportant factor in finishing new equipment where painting starts early in construction, but highly important in refinishing where traffic through the paint shop must be kept moving.

SOLVENT PRICE TREND

Close adherence to quoted prices was evidenced during the past month in the market for solvents and diluents. Minor revisions included an advance in benzene and declines in butyl alcohol and butyl acetate resulting in a slight decline in the solvent price trend index number to 92.97 as of November 15th.

TECHNICAL DEVELOPMENTS

The items in this column are gathered from many varied sources. Further information on any of them may be obtained by writing to U. S. I.

U S I

"Excellent waterproofing" of fabrics and paper is claimed for a new process covered by a foreign patent. Metallic soaps are used to impregnate the material which is treated, either during the impregnation or afterwards with a solution of formaldehyde. Zinc or aluminum soaps are suggested as suitable.

U S I

A solvent filter for the extraction of solids and colloidal matter from solvents is available that employs a number of "candles" of diatomaceous earth. Two sizes are available. Capacities vary depending on the viscosity of the fluid being handled but the smaller unit with eight "candles" has an average capacity of eight gallons per minute. Principal use is in the filtration of solvents used for washing parts of equipment where constant movement is encountered.

U S I

A spray painting machine for coating paper is now on the market. It was primarily designed for coating large uncut sheets of playing cards with a glossy finish but it is also suitable for other similar uses. Sheets are fed in on an endless wire mesh conveyor and travel past three spray guns. An exhaust chamber is provided to collect spray mist. Sheets are delivered automatically to another conveyor which carries them through a drying chamber.

U S I

A novel paint striping tool which applies two colors in either two or three lines in the same operation has been placed on the market. It is a small self-contained unit weighing but 12 ounces, has three striping nibs, an adjustable guide to assist in handling, and may be had with one-ounce or two-ounce color cups. The two outside nibs are arranged to slide back and forth so that the tool can be used on uneven as well as smooth surfaces.

U S I

A new process of waxing wood to the core instead of merely on the surface has been developed at the U. S. Forest Products Laboratory. According to the report, the wood is first subjected to chemical treatment that makes it permeable to the melted wax. Stearin and beeswax have been successfully employed, and linseed oil, rosin, and other substances that will mix with the wax may also be used. The process is said to render the wood waterproof and resistant to warping, shrinking, checking and cracking.

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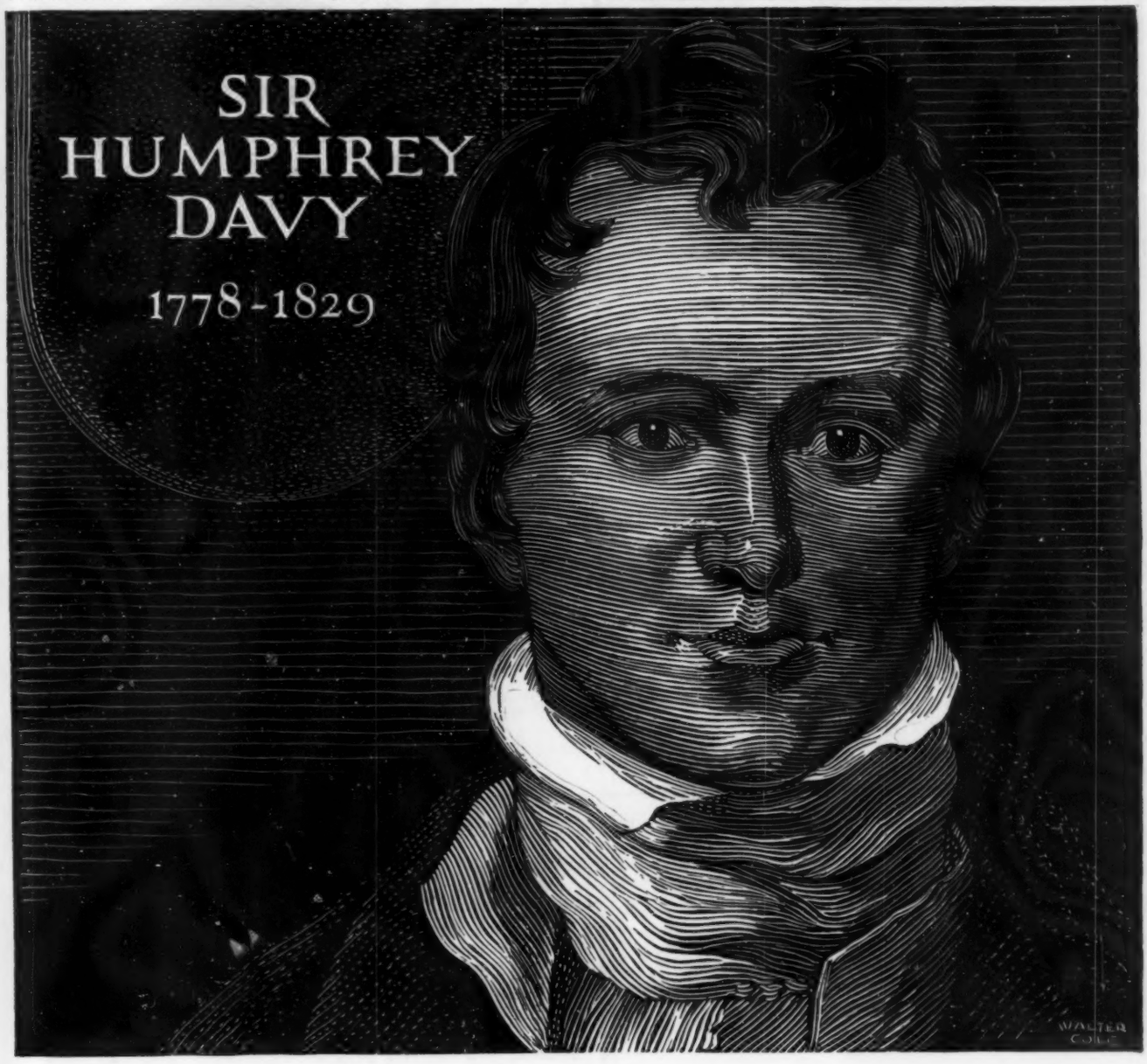
NUMBER THREE OF A SERIES OF FAMOUS PIONEERS IN CHEMICAL HISTORY



Apprenticed to a surgeon and apothecary at the age of fifteen, Davy was appointed to the Royal Institution in 1801 at the age of twenty-three and was knighted eleven years later. His health failed, however, while he was still at the height of his career and he died in 1829 at 51. Davy is said to have been one of the first to use the electric current for thorough and fundamental chemical investigation.

IN 1807 fashionable London paid twenty pounds a head to watch Sir Humphrey Davy at the Royal Institution perform the miracle of the age—to see him produce small quantities of metallic sodium by means of a new-fangled electrical apparatus. Davy's epoch-making discovery and his pioneer work with Faraday in experimental electricity marked the beginning of the modern electrolytic process for manufacturing caustic soda. Mathieson, pioneer producer of high purity caustic soda both by the electrolytic and ammonia-soda processes, has also pioneered the distribution of caustic soda in liquid form to large consumers. Mathieson Caustic Soda is now supplied to industry from three strategically-located producing points — Saltville, Va., Niagara Falls, N. Y. and Lake Charles, La.

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Division of United States Rubber Products, Inc.
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THAN THE WAY IT'S INSTALLED!

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Armstrong's Finish Materials include, in addition to various asphaltic emulsions, white cold storage paint for cold rooms and cold lines, aluminum cold storage paint, and seam filler.

View of cooling room of Borden Sales Company, Buffalo, N. Y. This cooler is insulated throughout with two layers of 2" Armstrong's Corkboard. The interior is finished with Armstrong's Plastic Finish and painted with Armstrong's Aluminum Paint.

~ ~ ~

TO insure the maximum efficiency and permanence of insulation, it is essential not only that the correct thickness be used, but also that it be carefully and *properly applied.* Development work during the past few years has resulted in marked improvements in finishes for insulation. Armstrong manufactures a complete line of materials for use in applying Armstrong's Corkboard and Armstrong's Cork Covering.

Among the insulation sundries developed for use in erection are: Armstrong's No. 3 Asphaltic Paint, to prime and air-proof concrete or portland cement plaster surfaces; Erection Asphalt, a special odorless asphalt for erecting corkboard in cold rooms; No. 236 Waterproof Cement, a quick-setting cement for applying corkboard against wood, steel, concrete, portland cement plaster, and corkboard; Armstrong's No. 299 Waterproof Cement, an alkali and acid-resistant cement for applying cork covering and cork lagging.

For finishing purposes, Armstrong has developed and manufactures new asphaltic finishes, made from asphalt emulsions, which are especially suited for use in cold storage rooms, on refrigerated equipment, and on insulated equipment in air conditioning installations. Armstrong's Insulation Finishes are practical, moisture-resistant, and can be applied over other surfaces or finishes. In addition, all these finishes are easily handled; will not chip or peel; and give efficient, lasting service.

Each Armstrong office is staffed with men thoroughly experienced in the proper erection of insulation. Call on them at your convenience. They will be glad to serve you.

Armstrong's Erection Materials are especially designed for cold room and cold line application, are easily handled, and give efficient service.

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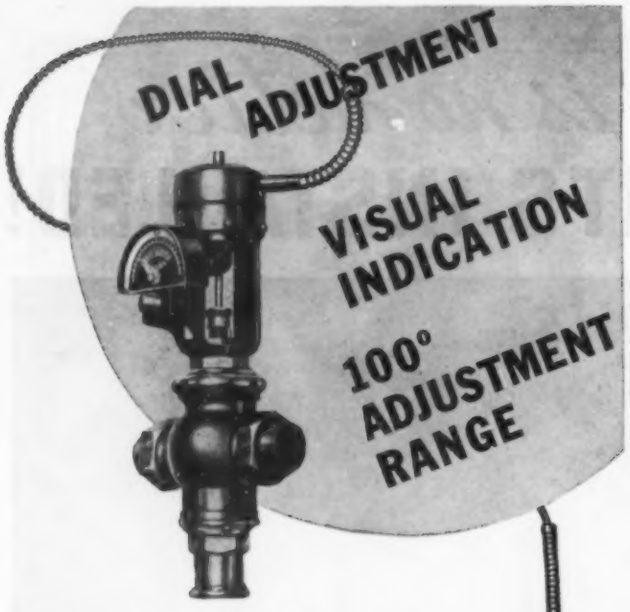

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Hence, it permits the operator to readily select the proper setting for each product and each step in a process, with minimum opportunity for error. Then, this simple self-contained, self-powered regulator automatically maintains the temperature selected within extremely narrow limits.

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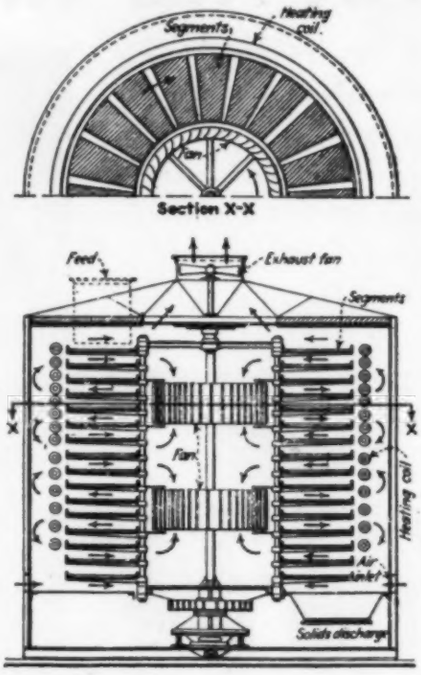

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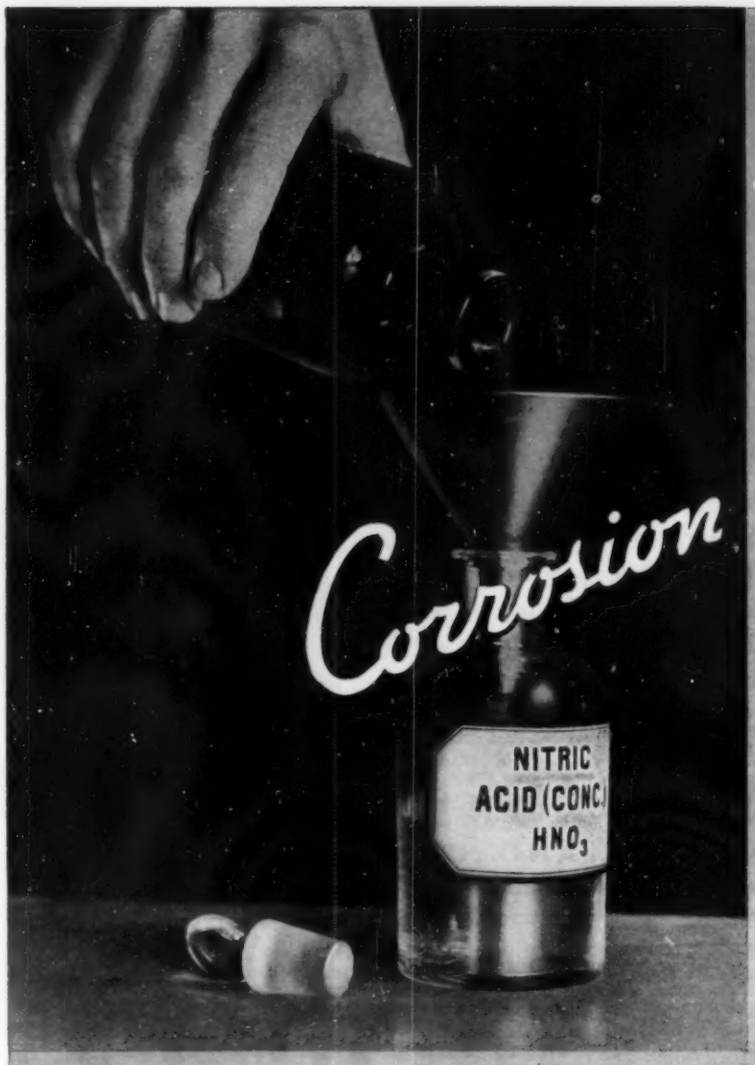

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ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation

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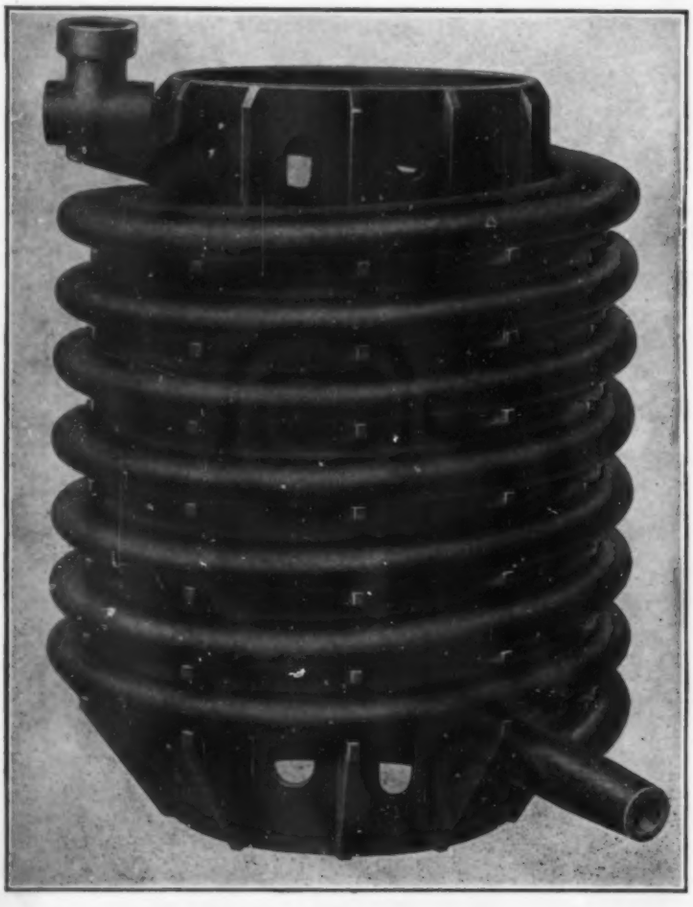


Practically

DOUBLE

capacity

This new DUPLEX condensing coil, made of Genuine General Ceramics Chemical Stoneware, is a remarkable ceramic achievement. Two parallel tubes, each 1½" inside diameter by 56 feet long, with a wall only ⅛" thick, are wound on the same drum. The tubes are connected at the top and bottom into one inlet and outlet. This construction practically doubles the amount of cooling surface that can be furnished in a given space.

GENERAL CERAMICS COMPANY

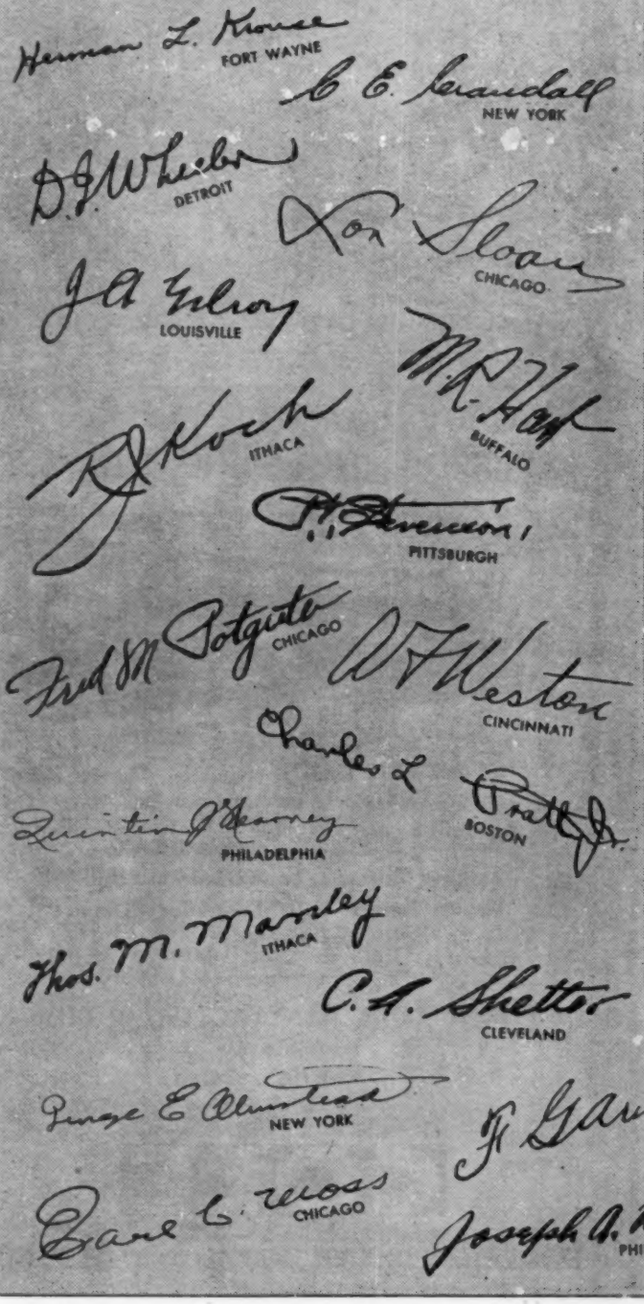
CHEMICAL STONEWARE

30 Rockefeller Plaza, New York

Buffalo, 306 Jackson Building
Chicago, 208 South LaSalle Street
San Francisco, 276 Monadnock Building
Montreal, 1009 University Tower

Thank You!

1935 A BIGGER AND BETTER YEAR



It's been a great year for Morse. Thousands of customers, both new and old, have given Morse a generous share of their business during 1935. Throughout industry there has been a definite upturn in business—plants are being modernized, definite savings are being made in production costs and Morse is endeavoring to meet these demands through careful, considerate service to industry.

Morse is also keeping pace with modernization with new equipment at both Ithaca and Detroit plants. These increased facilities assure Morse customers of better service in manufacturing and delivery.

Morse takes this opportunity to thank industry for making 1935 a bigger and better year, and also to show its appreciation of the sincere and earnest efforts of these Morse men in the field. With thorough knowledge and experience in transmission of power, they are always ready to serve industry with better methods of power transmission.

MORSE

Silent and Roller Chains and Sprockets
Flexible Couplings and Clutches

Morse Magic Silent Chain Drive Selector automatically selects the proper drive, checks and designs chain drives, saves time. Send for one. It's free.

Morse 1936 Calendars are now ready. Ask for your copy.

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Division of Borg-Warner Corporation

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REG U S PAT OFFICE

gives long, satisfactory service under High-Pressure Steam and Compressed Air, because it is all asbestos of the very highest grade, and carries an amount of graphite-grease lubricant that prevents it from hardening in service.

Insures fewer packing renewals and less interruption to operation.

Length of service determines the true cost of a packing.

Send for A B G Chart showing
"CUTNO" packing for Caustic Soda and similar chemicals;
"SUPER-CUTNO" packing for Sulphuric and other acids;
"PALCO" packing for water pressures.

Why not let us send you free working samples of these packings to test out under your own working conditions?
STATE SIZE REQUIRED

GREENE, TWEED & CO. *Sole Manufacturers* 109 Duane St., NEW YORK

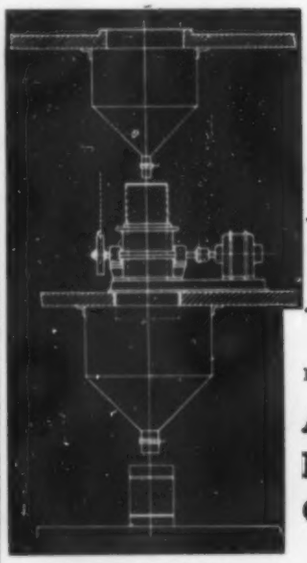
NEW ... AMERICAN 9x9 HAMMER MILL

... WILL CRUSH OR PULVERIZE PRODUCTS AT LOW COST...

This important development has made it possible for the small manufacturer, as well as the large, to crush or pulverize tons of materials and realize larger savings.

The flexible unit, is of compact and simple design—it occupies no more space than an ordinary office desk when installed with motor ready for operation.

Many features of our larger and widely used units are incorporated in this newly developed laboratory type mill assuring dependable results.



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Write for complete details. We make Grinding Equipment for all kinds of chemicals. Tell us your problems.

Originators of the
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AMERICAN PULVERIZER COMPANY

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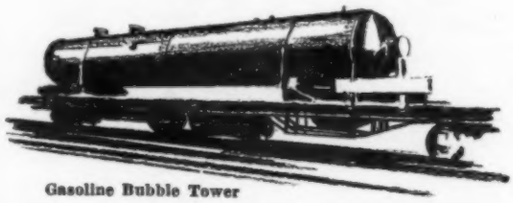
STEEL and ALLOY STEEL PLATE FABRICATION

Exactly to specifications



Gasoline Bubble Tower

TANKS *and* VATS made from monel, Lukens nickel clad steel, or other metals.

Boilers—HRT	Jacketed Kettles
Agitator Tanks	Welded Steel Pipe
Bubble Towers	Creosoting Cylinders
Gas Scrubbers	

R. D. COLE MANUFACTURING CO.
Established 1854
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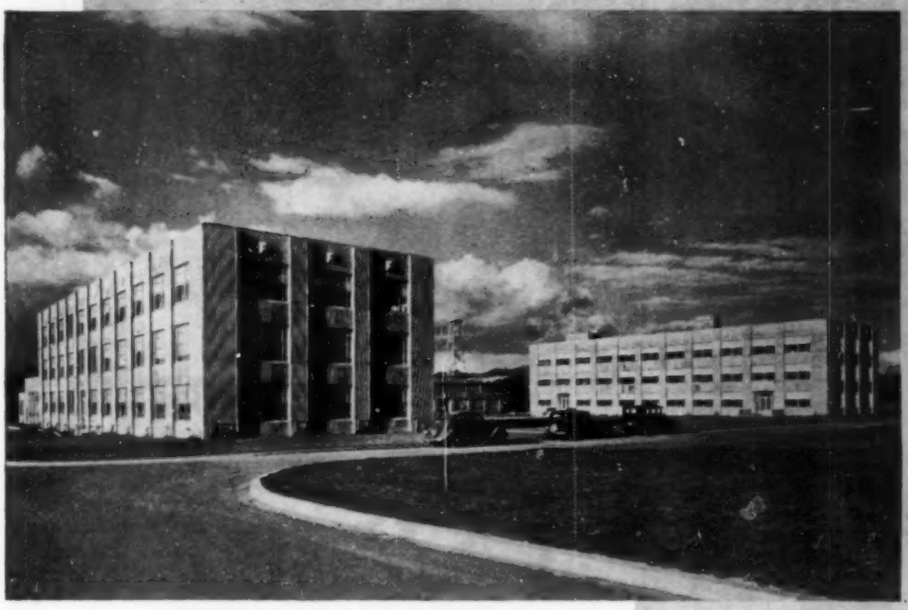
COLE

FABRICATORS OF STEEL AND ALLOY STEEL PLATE

GULF TECHNICAL OILS MEET EXACTING REQUIREMENTS FOR PROCESSING



Here is Gulf's new research laboratory, near Harmarville, Pa. In this laboratory Gulf scientists undertake to find the solution to thousands of problems, dealing with the production, manufacture and field of service for petroleum and its products.

Below is some of the general organic research equipment used by Gulf scientists to determine the chemical construction of petroleum oils and their adaptation to specific uses.

Save Money—Improve Your Finished Products—by Using

GULF TECHNICAL OILS

IF you are seeking a means to improve a manufacturing process, or if you are contemplating a new process, Gulf can be of assistance to you. Gulf scientists have developed a broad range of technical and process oils which are saving money for manufacturers of many different products.

Some of the many types of Gulf technical oils now available are listed on this page. A line addressed to your nearest Gulf District Office will bring complete information regarding any petroleum product for which you have need.

GULF REFINING COMPANY, PITTSBURGH, PA.

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Do you need a better oil for treating or processing your products? Are you contemplating a new manufacturing process in which petroleum products may be used? Gulf's technologists will be glad to consult with you. The coupon is for your convenience.

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GULF TECHNICAL AND PROCESS OILS

Check now and use coupon below

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- Electric Cable Oil
- Electric Switch Oil
- Electrical Condenser Oil
- Electrical Impregnating Oil
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Chester, Pa.

MONARCH SPRAY NOZZLES

HARD RUBBER

Fig. 621-A. Desirable for use with certain acids. Tip may be renewed or interchanged, thus reducing repair costs. ⅛" to ½" pipe sizes.

Catalog 6-C

FIG. 645

STONEWARE

Wear is comparatively slight as both nozzle and disc are made of stoneware. Will last almost indefinitely in sulphur gases, being acid proof and non erosive.

Catalog 6-C

This figure 645 nozzle is used for air washers, washing acid phosphate gases, etc. Made of cast brass, and may be had with either hollow or solid spray. Pipe sizes ¼" to 1"

Catalog 6-C

For Air Conditioning—Monarch ¼" Fig. H-261 male or Fig. 642 female pipe thread brass nozzles are recommended. Capacities from .57 to 18.17 G.P.H. at 40 lbs. The 2.20 gal. size at 25 lbs. is mostly used.

Bulletin No. 20

MONARCH MFG. WORKS, INC.

2730 E. WESTMORELAND ST.

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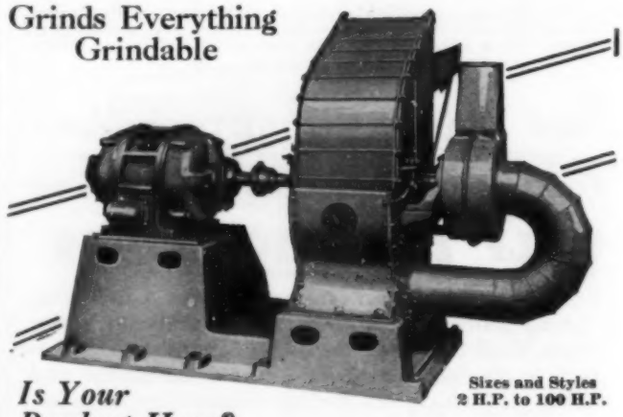
Grinds Everything Grindable



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We can solve any grinding problem. Write for specific information on your particular requirement.

World's Standard Grinder

Over 20,000 "JAY BEE" all-steel hammer mills in use all over the world, setting the standard for capacity — durability —and economy.

"JAY BEE" grinding units are compact, complete — require little floor space. Reduction cost lower than with any other grinding process.

J. B. SEDBERRY, INC., 142 Hickory St., Utica, N. Y.

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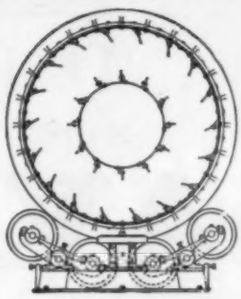
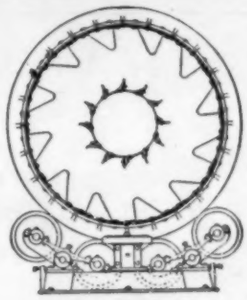
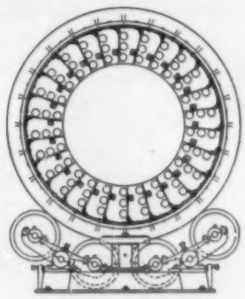
Direct Heat



Double Shell
Semi-Direct Heat



Double Shell
Indirect Heat



Steam Tube
Indirect Heat

Rotary Dryers

For Clay—Coal—Chemicals—Stone—Sand—Concentrates—Sewage Sludge—or what have you?

38 years' experience in drying in over 2000 Ruggles-Coles Dryers of 12 distinct types is your insurance you won't go wrong if you follow our recommendations. Write for Bulletin 16-B.

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YORK, PA.—Main Office & Works Chicago—205 W. Wacker Drive
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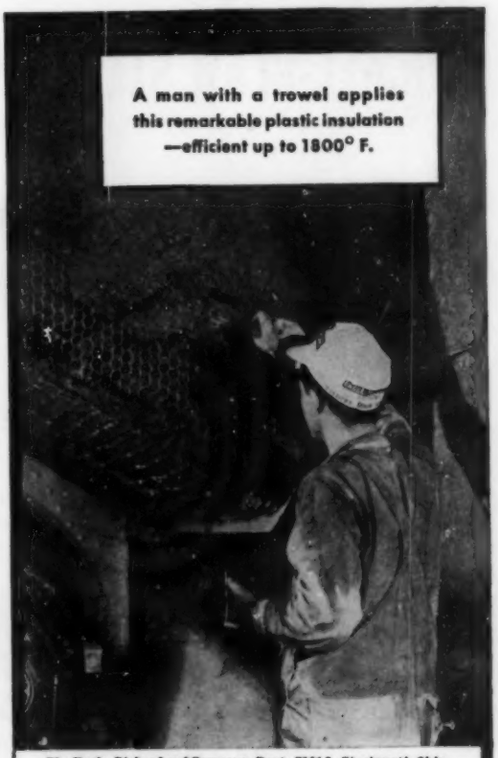
Ruggles-Coles Dryers

Easy TO STOP HEAT LOSS WITH EAGLE "66"

● Eagle "66"—a plastic insulation designed for easy application on practically all kinds of heat producing and heat transferring equipment. Made by a special process that forms small "springy balls" of Eagle Insulating Wool. Each of these "springy balls" contains thousands of tiny dead-air cells. They remain intact after the insulation has been mixed with water, applied and dried—giving Eagle "66" its remarkably low thermal conductivity, its unsurpassed heat-saving efficiency.

Before you do another insulating job, get a sample and all the facts about Eagle "66" Plastic Insulation. Mail the coupon below.

See Sweet's Engineering Catalogs for specifications on Eagle "66"—also for complete Eagle-Picher line of insulating materials, effective for a full range of temperatures.



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The Eagle-Picher Lead Company, Dept. CM12, Cincinnati, Ohio.

Please send me free samples of Eagle "66" Plastic Insulation; also descriptive catalog.

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MADE OF

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"The Material That Defies Corrosion"

The same qualities which have resulted in the widespread use of Haveg as a construction material in tanks, towers, pipe, fume duct, and other equipment have similarly led to its adoption as a construction material for fans and blowers.

The standard line of fans includes four sizes, with capacities ranging from 500 to 10,000 cubic feet per minute, at static pressures up to three inches of water.

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Fabricated from One Plate by DOWNINGTOWN

Given: The job of fabricating two steel shells, 12'6" long and 6' in diameter.

The Method: The use of the shells called for 20% Nickel-clad Steel. Single plates were cut, formed and welded.

The Result: A superior fabricating job, strong and tight . . . another satisfied Downingtown customer.

Downingtown is equipped . . . in Metallurgical and Engineering knowledge, in Fabricating Equipment and in approved Welding Facilities . . . to turn out any desired steel plate fabrication for the process industries. Any material-Carbon Steel, Chrome Iron and Chrome Nickel Alloys, Nickel Clad Steel, "Everdur," Aluminum, "Monel" Metal, Pure Nickel or Stainless Clad Steel. Welded or riveted construction.

Write for our 32-page book describing the wide range of Downingtown jobs.

DOWNINGTOWN IRON WORKS

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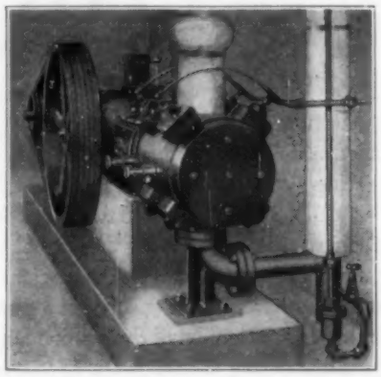
Main Office & Works, Downingtown, Pa. New York: 30 Church St.

PENNSYLVANIA

Steam Booster Compressors

Where steam is required for any purpose at higher pressure or temperature than can be supplied by an existing boiler plant . . . and where it is necessary that tem-



perature be continuously maintained within close limits . . . a Pennsylvania Steam Booster Compressor may save the cost of additional expensive boiler plant equipment.

Ask for descriptive bulletin No. 163

PENNSYLVANIA PUMP & COMPRESSOR COMPANY

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and "Scraper" Type are operating on over 35 different materials in the chemical industry alone.

There are over a thousand engineering and service reports covering not only filter data but data on the corrosive resistant properties of the materials used in the fabrication of our several hundred installations.

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RUBBER LINED STEEL TANK

THE HAUSER-STANDER TANK CO.
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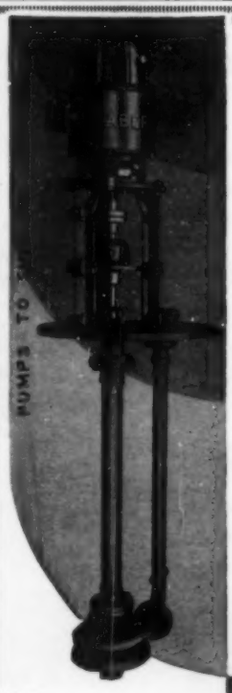


5344

SUBMIT YOUR PUMP PROBLEM DIRECT

All-Niresist

Fig. 19415 to the left is one of a battery of pumps recently built for a large chemical plant. Made completely of Niresist Alloy and especially designed to operate in pressure vessels.

This pump is another illustration of Taber's ability to build pumps to suit the service. Taber Pumps can be made of various castable alloys as well as iron, steel or bronze.

Comprehensive Bulletin No. G-631 gladly mailed to you on request.

TABER PUMP CO. Est 1859

294 Elm St., Buffalo, N.Y.

NICKEL increases life of Screw Conveyors More than 100 Times

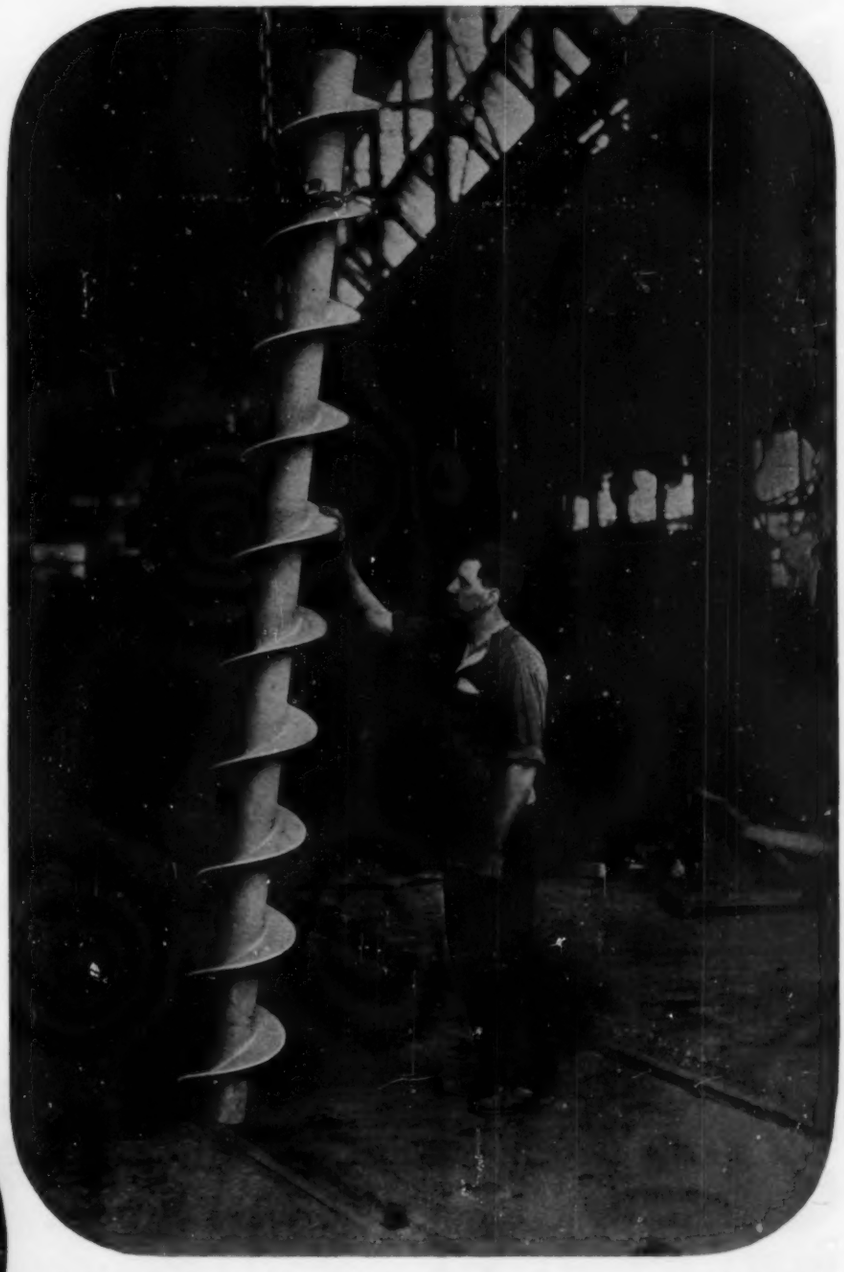
● The well-known ability of Nickel to increase the dependable service life of cast steels is indicated by the performance of the screw conveyor pictured here.

These screws convey Portland cement clinker at temperatures frequently reaching 1000° F.

Despite extreme abrasion under high temperatures, these Cast Nickel Steel screws, are still in operation after two and a half years of service.

Fabricated conveyors previously used gave but 7 to 10 days service.

Our casting specialists are always glad to recommend suitable compositions and best modern practices for any specific need for Nickel Steels and Irons.



NICKEL
CAST STEELS

● One of a number of Nickel Alloy Steel conveyor screws designed and cast by Chicago Steel Foundry Co., Chicago, Ill. These screws are each 12 in. dia. x 11 ft. long, cast in one piece, with 4 in. hollow shaft.

The material used is "Evansteel," a cast steel containing usually 1.50% Nickel, .75% chromium and .30% carbon.

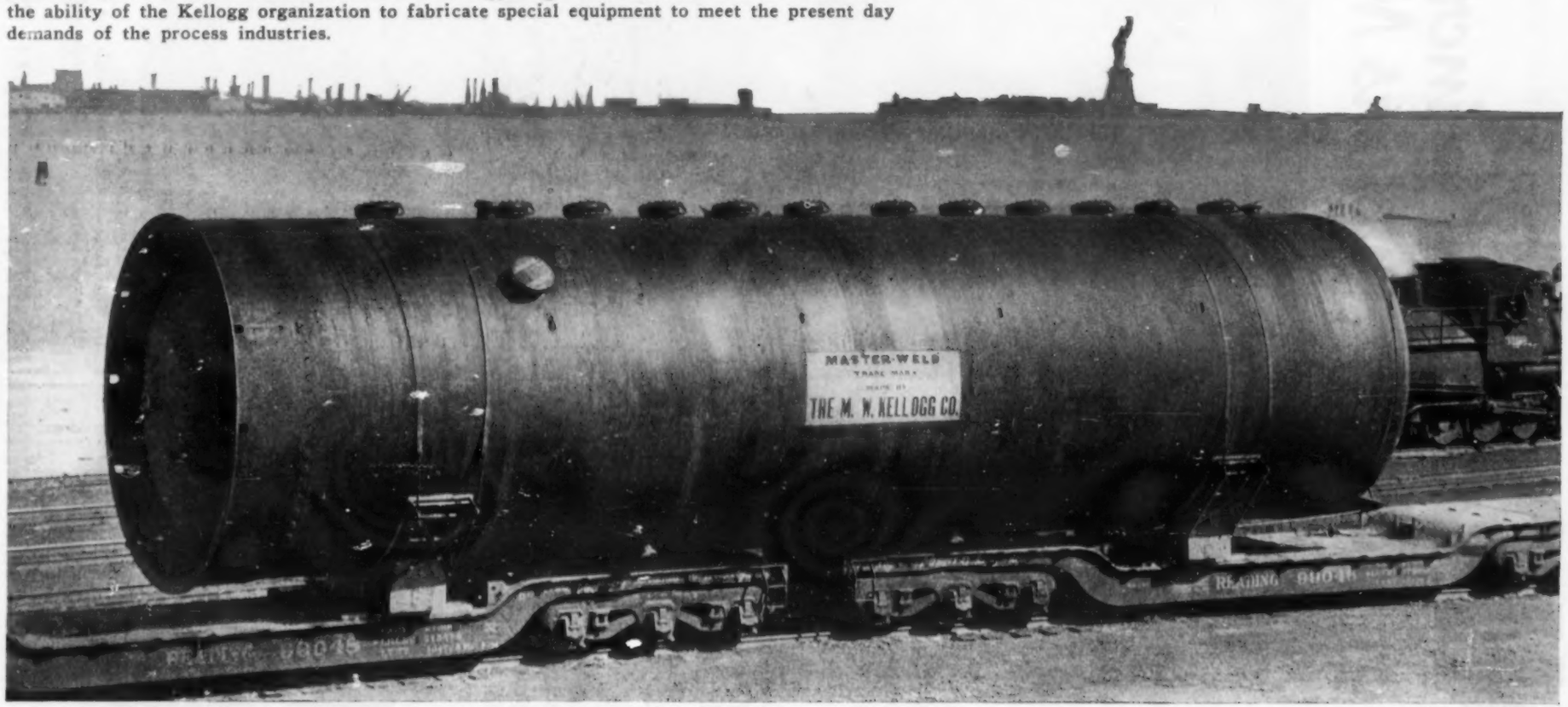
This Foundry also recommends for temperatures from 1000 to 1900° F. its "Pyrasteel," a heat resisting alloy containing high percentages of Nickel and chromium.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

150 TON KELLOGG FLASH TOWER

16 ft. in diameter by 67 ft. long overall—1 in. thick

This is one of the largest vessels ever shop fabricated for shipment to a distant point. Each section is made from a single carbon steel plate one inch thick, 10 feet in width and 50 feet 6 inches long, containing over 500 square feet of area. This is the largest surface area ever rolled. The heads are so large they could not be flanged or dished in one piece, so were made from two sections and "Masterwelded" in the Kellogg shop. This tower is further evidence of the ability of the Kellogg organization to fabricate special equipment to meet the present day demands of the process industries.



THE M. W. KELLOGG COMPANY . JERSEY CITY, NEW JERSEY
225 BROADWAY, NEW YORK

LOS ANGELES: 1031 SOUTH BROADWAY . BIRMINGHAM: 827 BROWN-MARX BUILDING . HOUSTON, TEXAS . TULSA: PHILTOWER BUILDING

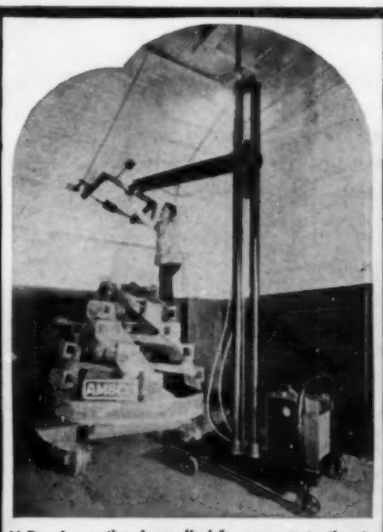
AMSCO Alloy for Corrosion Resistance!

AMSCO Alloy, a series of chromium-nickel alloys, is designed in several of its grades for maximum corrosion resistance. It is time tested and proved by over eight years of use in hundreds of industrial applications. It is strong — durable — readily machinable, and the ideal alloy for numerous machine and equipment parts subjected to the action of corrosive liquids or gases.

In pump parts, fittings, valve bodies, flanges and special castings of many types and shapes, AMSCO Alloy will deliver highly economical performance.

Also made for use where complete heat resistance is required, AMSCO Alloy resists temperatures up to 2100°F. Properly applied it does not burn, crack, scale, bend or warp!

For trouble-proof service — *specify AMSCO Alloy on all heat and corrosion resistant parts!*



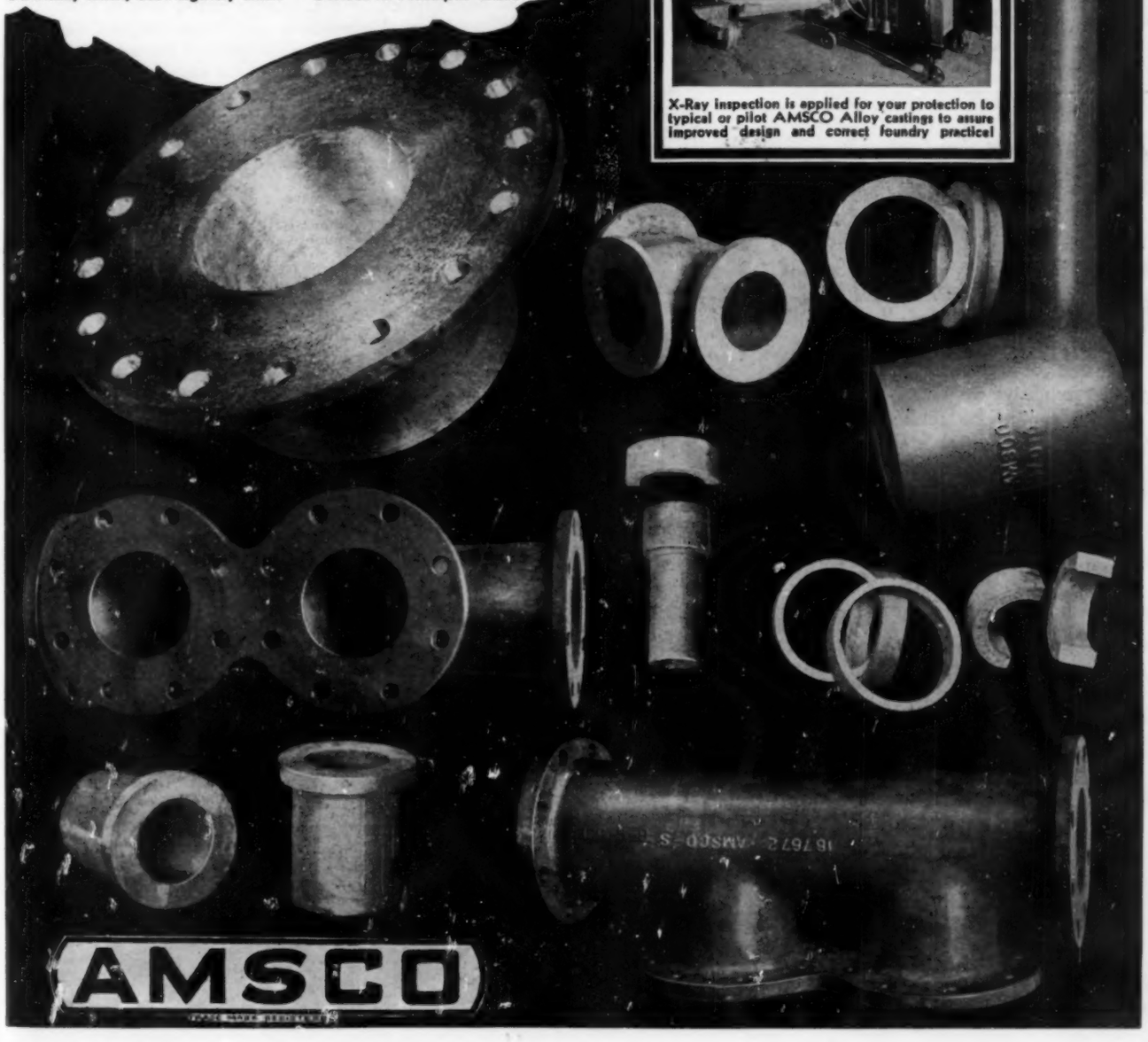
X-Ray inspection is applied for your protection to typical or pilot AMSCO Alloy castings to assure improved design and correct foundry practice!

AMERICAN MANGANESE STEEL COMPANY

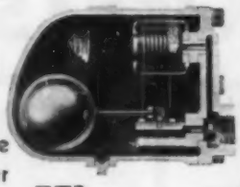
Division of American Brake Shoe & Foundry Company

401 East 14th Street, Chicago Heights, Ill.

Foundries at Chicago Heights, Ill.; New Castle, Del.; Denver, Colo.; Oakland, Calif.; Los Angeles, Calif. • Offices in Principal Cities



Don't Try To Pick Steam Traps Blind-Folded!

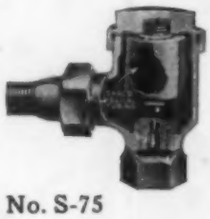


FTL

A steam trap right for one purpose will often prove unsuitable for another condition. Large sums are wasted by trying to use the same kind of steam trap for every industrial application.

Sarco has long recognized that there is no "universal" steam trap, therefore provides several different types from which to select the one best suited.

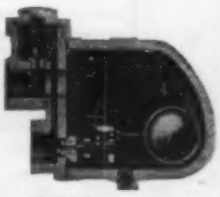
Sarco No. 9-2 Thermostatic Steam Trap leads the line. This is the type which changed engineering practice from old-fashioned group trapping, by means of a few large, centrally located traps, to individual trapping (a trap on every coil).



No. S-75

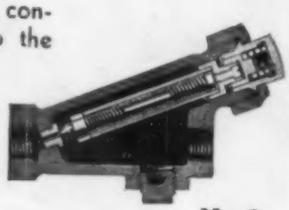
This is the system we recommend for most steam-heated process equipment, operating at pressures *from 0 to 125 lbs.*

For applications where condensate must be removed as fast as it forms, regardless of the heat units thus wasted, Sarco Float-thermostatic Steam Traps are best adapted. These are preferred, for example, on large unit heaters, hot water generators, and calenders (or dry cans) in textile mills.



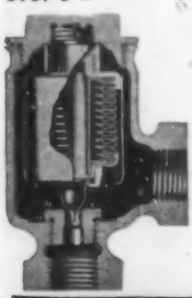
FTH

On extensive systems, where condensate cannot be returned to the boiler, there is no better or more economical steam trap than Sarco No. 8. Even on high pressure (up to 300 lbs.) it discharges only cool condensate with a minimum of "flash" steam.



No. 8

No. 9-2



Put your steam trap problems up to us. Write today for Catalog AF-48 and full information. There is no obligation, and our experience in this special field may save you money and help you.

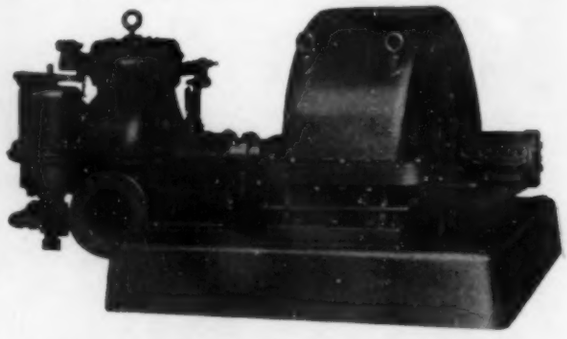
SARCO COMPANY, Inc.
183 Madison Avenue
NEW YORK, N. Y.
Branches in Principal Cities
Sarco Canada Limited, Federal Bldg.
Toronto, Ont.

SARCO STEAM TRAP

Gas Compressors
ENGINEERED by "RC"
for specific performance

You can depend on Roots-Connersville Blowers, Exhausters and Compressors for successful operation with maintained efficiency over many years of hard service. "R-C" engineering sees to that. When unusual conditions call for specialized design, the experience and facilities of our organization are at your command. Our wide experience has helped, too, in the development of standard "R-C" units that perform efficiently under the exacting conditions imposed by many types of service. Whether you need special equipment or standard units, our recommendations imply no obligation. Ask for them — and Bulletin 120-B10.

"R-C" Centrifugal Gas Compressor in use at one of the leading chemical plants in the U. S. pumping ethylene, 2500 cu.ft. per minute, against 10 lbs. pressure. The pump has a built-up stainless steel rotor and is steam turbine driven.



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CONNERSVILLE, INDIANA
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Sheets, Plates,
Forgings, Welded Tubing,
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Resists . . .

Hydrochloric Acid
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HASTELLOY "C"

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Castings, Welding Rod

Resists . . .

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(moderate temperatures)
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● Laboratory tests and hundreds of plant installations indicate the exceptional resistance of the Hastelloys to many corrosive materials.

However, there is only one sure method to determine the value of these alloys in solving your own particular corrosion problems. That is to test them under your own plant conditions.

Samples of Hastelloy have been prepared for just this purpose and will be furnished without obligation. Write for yours today.

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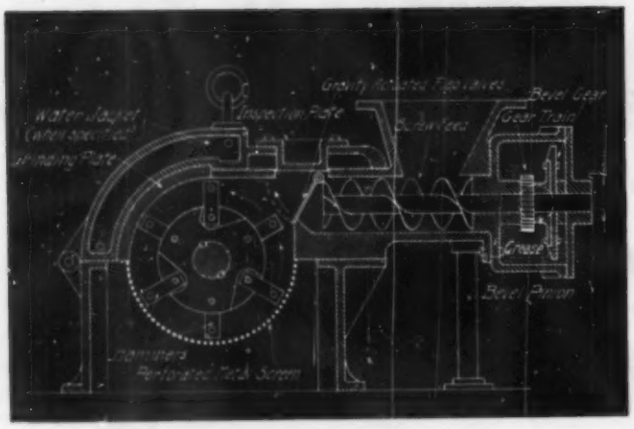


(PATENT PENDING)
Sectional view of the "Helix-Seal" Impact Pulverizer. Note the double seal formed by incoming material and the gravity actuated flaps.

Now!
Dustless Pulverizing
without fans or collectors
The "Helix-Seal" Mill

is Low in First Cost
Easy to Install
Cheap to Operate
Has Large Capacity
Delivers Finenesses of 20 to 325 Mesh.

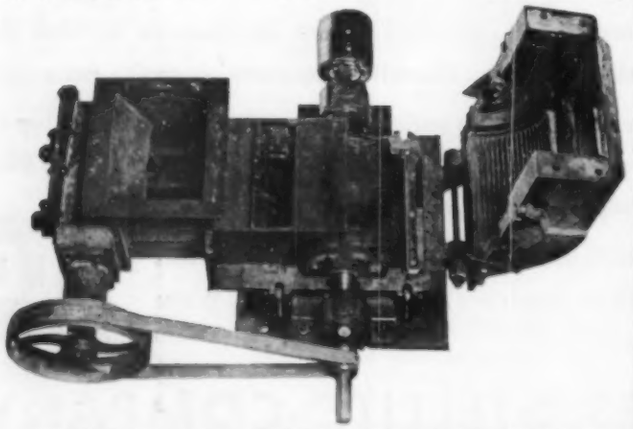
Dustless operation in fine and medium fine grinding is now possible without the extra expense and power cost of fans, collectors or other air handling equipment. Due to the exclusive double seal of screws and flaps in the "Helix-Seal" Mill, no air is sucked in by the guiding elements and consequently there is no discharge of dusty air. Built in several popular sizes, capacities 200 lbs. per hour and up.

Williams Patent Crusher & Pulverizer Co.
2706 North Ninth St., St. Louis, Mo.

Chicago
37 W. Van Buren St.

New York
15 Park Row

San Francisco
336 Rialto Bldg.



Top view of the "Helix-Seal" Mill with the cover raised. Attention is directed to the flaps at the discharge end of each screw. Middle flap has been partially raised and flap on far end fully raised to show operation.

Williams
OLDEST AND LARGEST BUILDERS OF HAMMERMILLS IN THE WORLD
WILLIAMS
PATENT CRUSHERS GRINDERS SHREDDERS

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For the Chemical Industries
In Stock — Immediate Shipment

Special steels—new alloys—that resist the various chemicals are carried in stock for immediate shipment. Men who know their possibilities and limitations with respect to chemical action, are ready to help solve your metal problems. Ask them for suggestions. Stocks include the newer steels, special alloys, stainless and cold finished steels, also non-ferrous metals and allied lines. We will be glad to send a copy of the Ryerson Stock List. Address the nearest plant.

Joseph T. Ryerson & Son, Inc., Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

STURDY IN EVERY PART

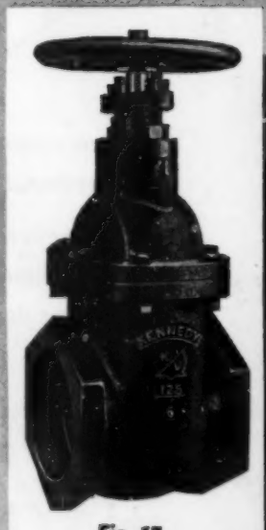

Fig. 57

LOOK at any Kennedy Valve in your dealer's stock. Notice the generous proportions of body, stem, flanges, bolts and hand-wheel. If you take a Kennedy Valve apart, you will find similarly substantial stem-operating mechanism and stem contact threads. The entire valve *looks* sturdy and *is* sturdy. You are always safe when you buy Kennedy Valves, whether gate, globe, angle or check types in iron body or bronze.

THE KENNEDY VALVE MFG. CO.
Elmira, N. Y.

KENNEDY
VALVES-PIPE FITTINGS-FIRE HYDRANTS

PLATINUM MASS CATALYSTS

ARE ECONOMICAL, EFFICIENT AND FLEXIBLE

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The equipment is compact and a small bulk of mass can be used. This keeps the power cost low.

Labor cost is comparatively small because due to their flexibility, platinum masses require minimum control for maximum efficiency.

Ninety per cent of the platinum can be recovered after ten years of service.

In 1934, using an average of five ounces of platinum per daily ton, the average investment per ton per day for platinum catalyst was $250.

EFFICIENCY

Platinum masses show high conversion rates even at those low temperatures where highest conversion is theoretically possible.

Platinum masses have low kindling temperatures.

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Platinum masses are efficient in all ranges of SO_2 concentrations encountered in practice.

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WHEN YOU BUY PLATINUM

Whenever you buy platinum metal, platinum chloride or finished contact mass, be sure you obtain only specially refined material. In purchasing from us, you are assured of the highest possible purity.

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NEW YORK SAN FRANCISCO CHICAGO

TONS OF "STAINLESS" USED...

—and not one pound wasted!

Many industries are profiting by the savings IngAclad offers. A cladding of finest quality stainless is bonded inseparably to inexpensive mild carbon steel, thus providing full stainless service on the side that is used, and cutting material cost by almost half.

Pineapple Juice Evaporator built by Eureka Boiler Works, Eureka, Calif., under plans of the Western Condensing Co., San Francisco. Shell Plates for main evaporator and auxiliary equipment were fabricated from IngAclad.

INGACLAD Trade Mark Reg.

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is made exclusively by the Ingersoll Ingot Patented Process, and is "A Borg-Warner Product."

It has proved its dependability in almost every branch of manufacturing, storing and transporting of products that require the protective contact surface of genuine stainless steel.

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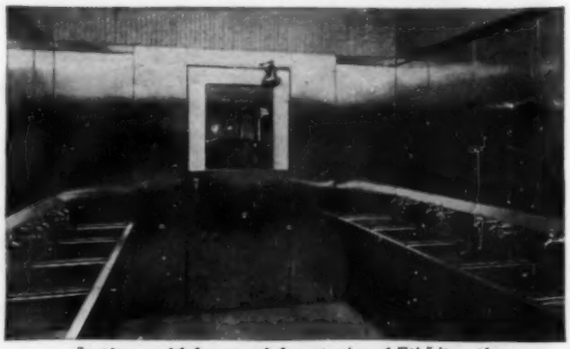
Fabricators are invited to write for "Manual of Welding and Fabricating Procedures for IngAclad"

Cereal Cooker used for cooking corn grits in the presence of live steam and salt. Fabricated by Waterous Limited, Brantford, Ontario, for a large Canadian manufacturer of cereals.



In the world-famous laboratories of Eli Lilly, the value of IngAclad Stainless-Clad Steel is recognised. View above shows portion of Gelatin Room

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Division of Borg-Warner Corporation

Specialists in High Carbon, Alloy and High Speed Steel and Stainless-Clad Sheets and Plates

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Plants: Chicago, Illinois, and New Castle, Indiana

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AMERICA'S INDUSTRIES FIND CRANE STOCKS

• Crane service in valves, fittings, and piping is a *localized* service. Within 24 hours of every factory in the United States, and within one to two hours of a great majority of them, complete stocks of Crane valves and fittings are available.

The Crane line is extensive, capable of answering the daily requirements of the 209,348 industrial establishments within the service areas where Crane stocks are carried.

Crane materials will help you solve any piping problem. If extensive modernization is contemplated, the Crane Finance Plan allows you to spread the cost over a period of years.

CRANE SHOP FABRICATION SERVICE

Design — Flanging
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There is a Crane Valve or Fitting for every piping requirement

ACCURATE

Crane Welded Header

1 Factory fabricated to exact dimensions specified—therefore easily installed.

2 Pressure tested for tightness at all points before approved by Crane inspectors.

3 Welds made by Hartford qualified welders.

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HAVE YOU A FILTRATION PROBLEM ?

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SPERRY LABORATORY SERVICE

For over 40 years Sperry engineers have been solving filtration problems for leading manufacturers in every branch of industry.

Samples of your materials will be tested as to their filtration ability in our own laboratories by the most advanced scientific methods, without any obligation on your part. Avail yourself of this service and thereby effect large savings in your initial outlay.

SEND FOR *Free* BULLETIN

Write at once for our illustrated bulletin containing a wealth of valuable information, charts, data, etc., on filtration problems, and fully explaining the Sperry Laboratory Service.

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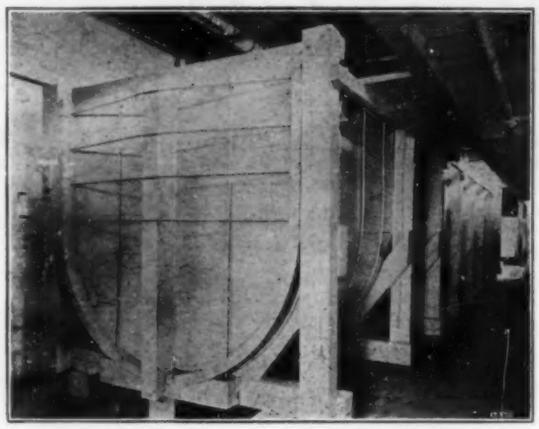


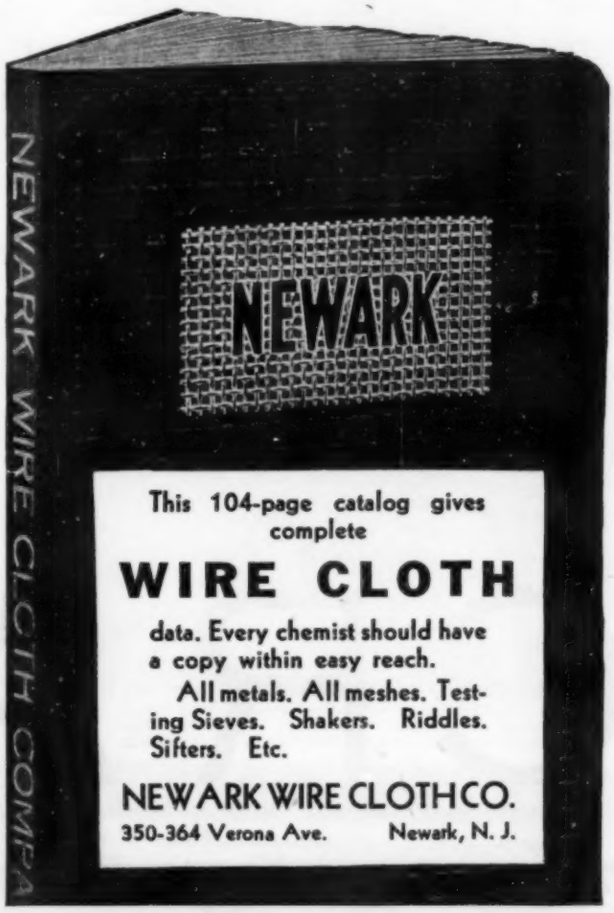
Chemical and other Industrial Plants often require Wood Tanks of unusual design and construction.

The above is a Round Bottom Settling Tank in a large Eastern Paint Manufacturing Plant.

Our Engineering Department will help solve your Tank Problems.

A postal request will bring a clever California Redwood Novelty without cost—mention Chem. & Met. please.

G. WOOLFORD WOOD TANK MFG. CO.
Paschall P. O., Philadelphia, Pa.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NEWARK WIRE CLOTH CO.
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Corrosion Resistant!

FEATURING POWELL ALL IRON VALVES

Powell rugged All-Iron Valves are used extensively for certain service conditions where the flow through the pipe line is destructive to bronze or the trim materials used in bronze and iron body valves. If your corrosion control problem cannot be solved by the installation of All-Iron Valves, let the Special Alloy Valve Division recommend the proper valve and the special alloy material or pure metal for your requirements.

Fig. 1462
Master Pilot Gate Valve

Fig. 171
Irenew Globe Valve

Fig. 1453
O. S. Y. Gate Valve

Fig. 1259
Swing Check Valve

For detailed listings on Powell Corrosion Resistant Valves, send for the Powell Corrosion Resistant Valve Booklet.

POWELL VALVES

SPECIAL ALLOY VALVE DIVISION • CINCINNATI, OHIO

4" Misco "C" "Centricast" pipe 35'—11¾" long

MISCROME 1 *(16% CR)*
MISCROME 2 *(28% CR)*
MISCO "18-8" *(18% CR—8% NI)*
MISCO "B" *(24% CR—12% NI)*
MISCO "C" *(29% CR—9% NI)*
MISCO "30-30" *(30% NI—30% CR)*
MISCO "N" *(20% NI—10% CR)*
MISCO METAL *(35% NI—15% CR)*
MISCO "HN" *(65% NI—15% CR)*

Your inquiries are invited. Bulletin No. C-2, containing technical and practical information on Misco "Centricast" castings will be sent on request.

MISCO
Heat and Corrosion Resistant Alloys

MISCO "Centricast" (Centrifugally Cast) PIPE AND TUBING

STAINLESS AND CORROSION RESISTANT

Misco centrifugally cast pipe is manufactured within very precise limits as to wall thickness and concentricity and combine the best corrosion resisting properties with light weight and rugged strength. Misco "Centricast" pipe and tubing may be had in any length, with outside diameters from 2" to 22", and wall thicknesses from ⅛" upward. Can be supplied flanged, threaded or with plain ends, and used in combination with conventional castings of any shape where special assemblies are required.

MICHIGAN STEEL CASTING COMPANY
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1983 GUOIN STREET, DETROIT, MICHIGAN

Do you operate a Pulverizer?

If you are now using pulverizers or if you contemplate purchasing pulverizing equipment you cannot afford to overlook the Mikro-Pulverizer. Our new catalog, just out, tells of dustless pulverizing without fans, cyclones or separators—tells of results you should expect and can have—it describes the modern Pulverizer—

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Making Carbon Dioxide since 1889, we have developed research facilities to handle even the unusual, never-before encountered problems. It costs you nothing to consult us as to how CO_2 can make new savings and improve processes in your plant. Red Diamond CO_2 is chemically pure, shipped in convenient pressure cylinders, usually available the same day it is ordered. Write if you do not already have our booklet "The Uses of Carbon Dioxide."

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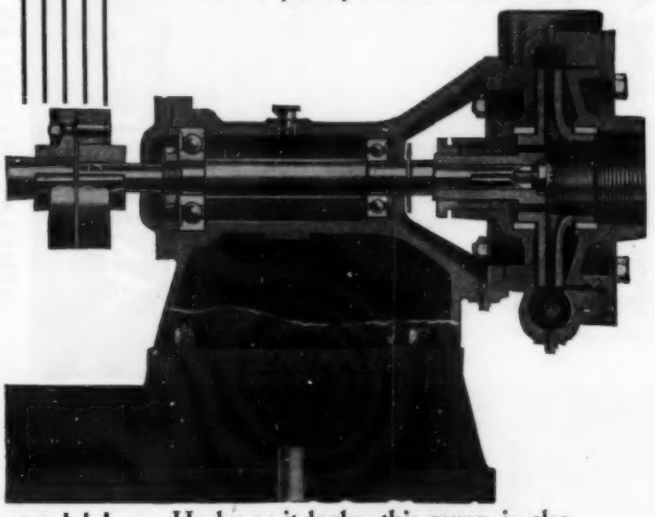
You benefit from "built-in" rigidity-

Have you ever wished that pumps required less attention—that they would operate steadily for months—yes, years, without wearing out impellers, side plates or bearings?

If you've wished for such pumps, you can buy them now! The Buffalo Full Ball Bearing Line, introduced about two years ago, fulfills every expectation of the most critical buyer of centrifugal pumps.

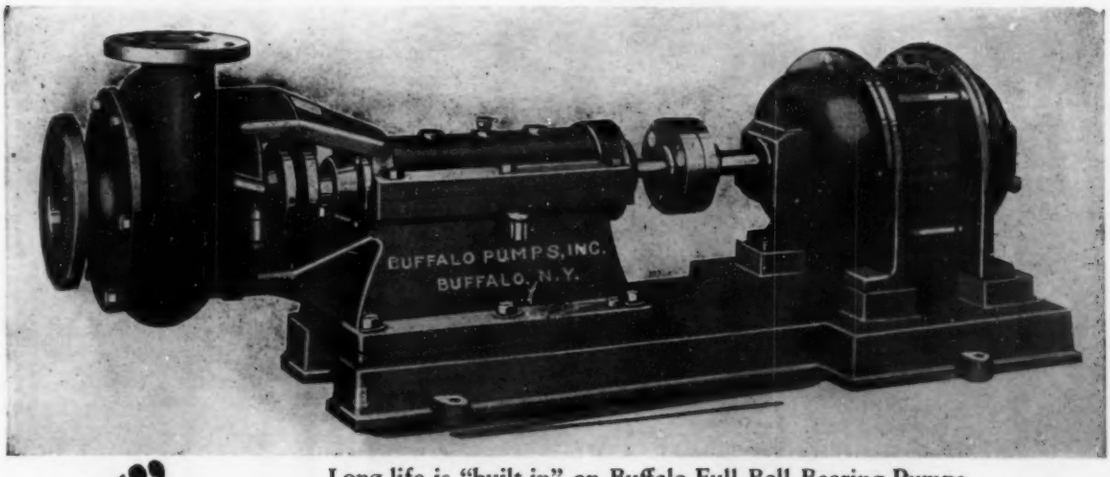
These pumps have excellent efficiencies which do not decrease in service because the Buffalo enclosed impeller does not wear, does not permit wedging or clogging when handling gritty or stringy liquids. Extra heavy construction throughout; oversize, heavy-duty ball bearings and shaft prevent miss-alignment and breakdown. Removable interchangeable pump end makes it easy and cheap to have pumps of various corrosion-resisting materials.

You benefit from the durability of Buffalo Full Ball Bearing Pumps. Write today for Bulletin covering the full line.



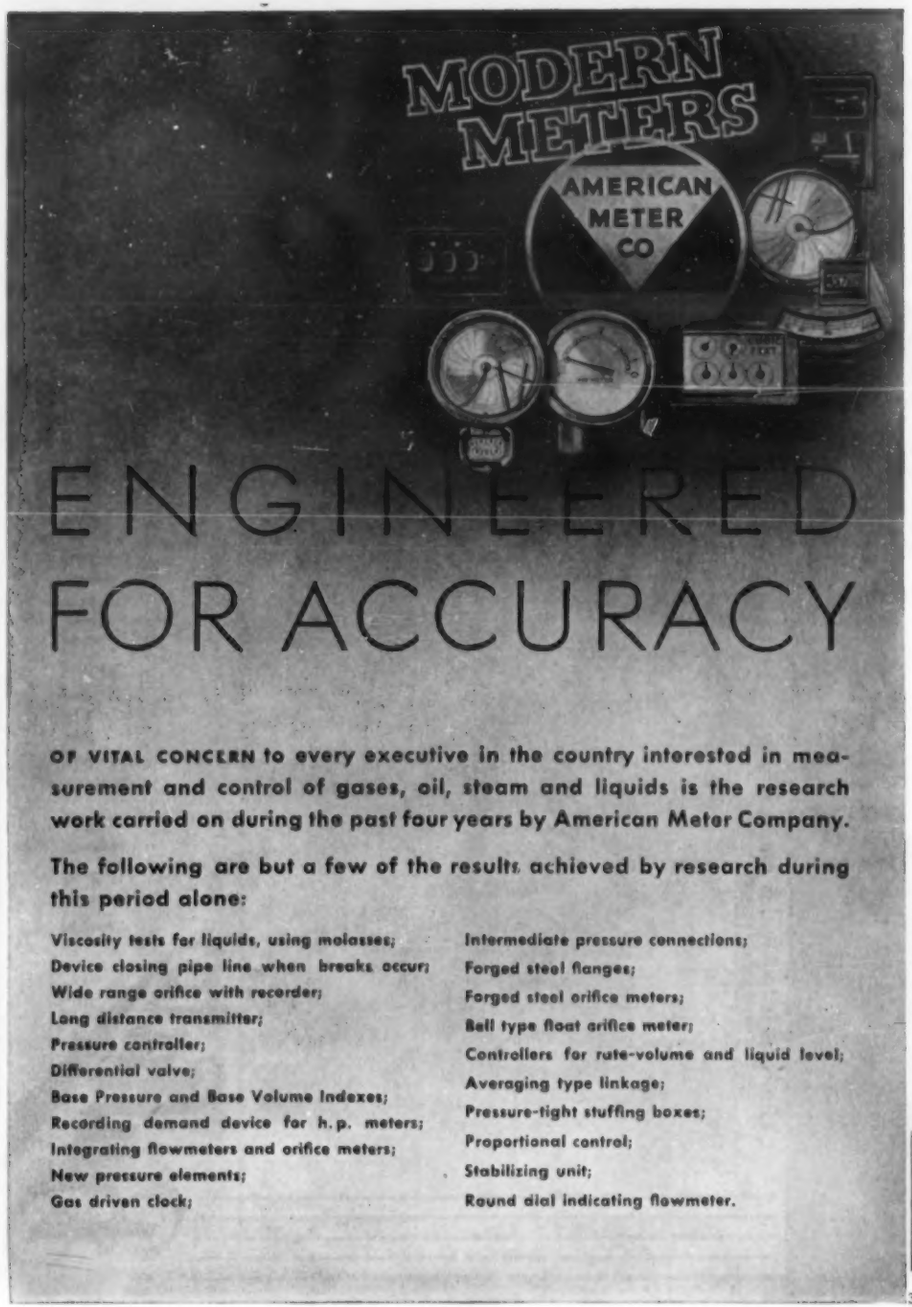
Husky as it looks, this pump is also EFFICIENT.

Buffalo Pumps, Inc.
501 Broadway, Buffalo, New York
In Canada: Canada Pumps, Ltd., Kitchener, Ont.



Long life is "built-in" on Buffalo Full Ball Bearing Pumps.

"Buffalo" full ball bearing pumps



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The following are but a few of the results achieved by research during this period alone:

Viscosity tests for liquids, using molasses;
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Wide range orifice with recorder;
Long distance transmitter;
Pressure controller;
Differential valve;
Base Pressure and Base Volume Indexes;
Recording demand device for h.p. meters;
Integrating flowmeters and orifice meters;
New pressure elements;
Gas driven clock;
Intermediate pressure connections;
Forged steel flanges;
Forged steel orifice meters;
Ball type float orifice meter;
Controllers for rate-volume and liquid level;
Averaging type linkage;
Pressure-tight stuffing boxes;
Proportional control;
Stabilizing unit;
Round dial indicating flowmeter.

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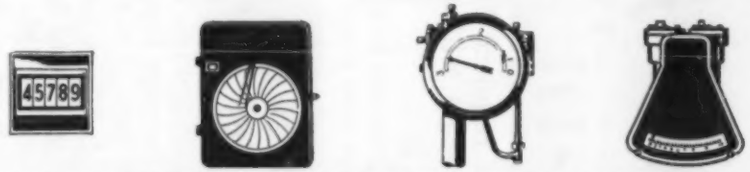

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RATE-VOLUME, LIQUID LEVEL AND PROPORTIONAL CONTROLLERS

Developed and manufactured to standards of accuracy established in the measurement of volumes as minute as the gas pilot light's flow. Notable for their extreme simplicity of construction. Fewer working parts. Fewer adjustments required . . . Upkeep costs greatly reduced.

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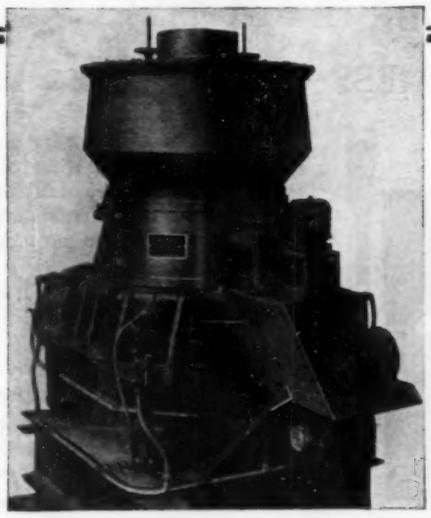
GENERAL OFFICES: 60 EAST 42ND STREET, NEW YORK, N. Y.

332

Two Types Of Mills For Every Pulverizing Need . . .



Whiting No. 1-A Table Roller Pulverizer

Two types of mills — table roller and impact — both with air separation, enable Whiting to handle every type of pulverizing operation

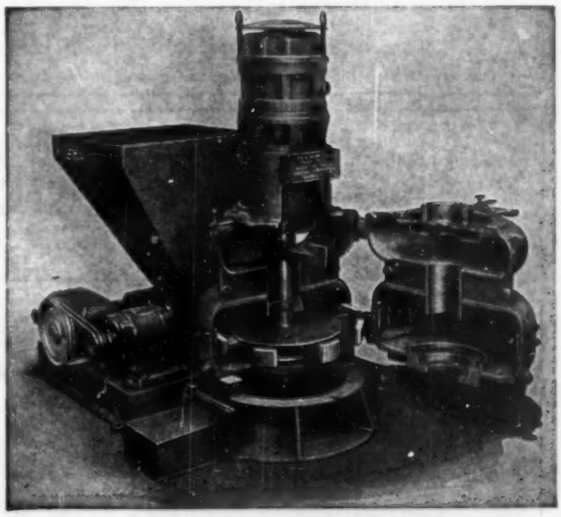
Table Roller Pulverizer In the table roller mill the material is pulverized by large rollers forced against single-piece track by spring pressure. Pulverization is accomplished through a decided attrition action in addition to crushing. Drying and pulverizing are accomplished at the same time by using hot air or gases.

Very economical to operate; requires 50% less power than any other type of pulverizing equipment. Automatic forced lubrication; not necessary to shut down for oiling.

Adapted to practically all kinds of materials, including:

Asbestos Products	Dry Colors	Limestone
Bauxite	Dyestuffs	Mica
Bentonite	Face Powder	Soap Powders
Borax	Fertilizers	Sulphur
Clays	Fullers Earth	Talc
Chalk	Gypsum	White Lead
Chemicals	Hydrated Lime	Zinc Skimmings
Coal	Kaolin	Filter-Press Products
Cocoa Cake		

For further description, ask for Bulletin No. 12



Whiting No. 3 Impact Pulverizer
Showing split housing

Impact Pulverizer The Whiting impact mill is the only vertical air separation mill made. The material is pulverized through impact with the revolving beaters against corrugated liners, the fines being separated by suction from the blower in upper part of pulverizer. This mill is being used extensively for pulverizing coal for firing metallurgical furnaces and boilers. It produces extreme fineness, as an example, 99.9% through 325 mesh on zinc oxide.

Full details in Bulletin No. 13

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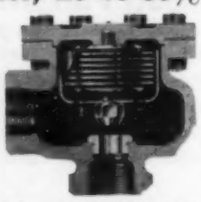

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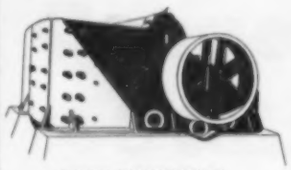

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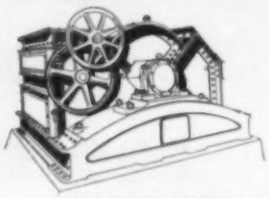

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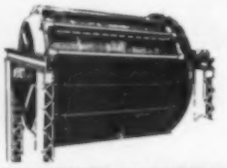

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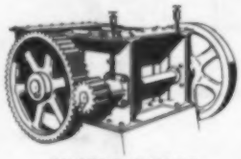

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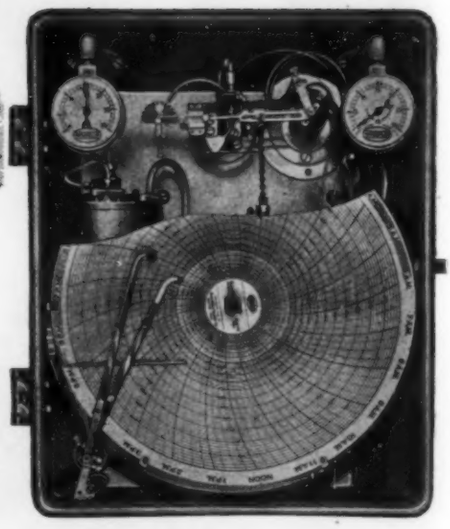

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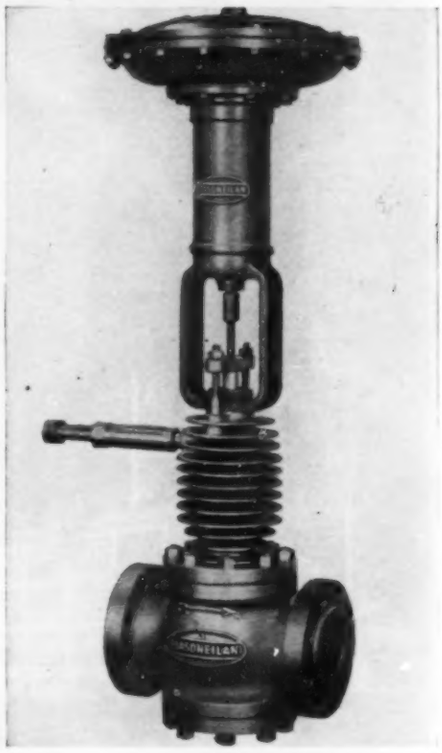

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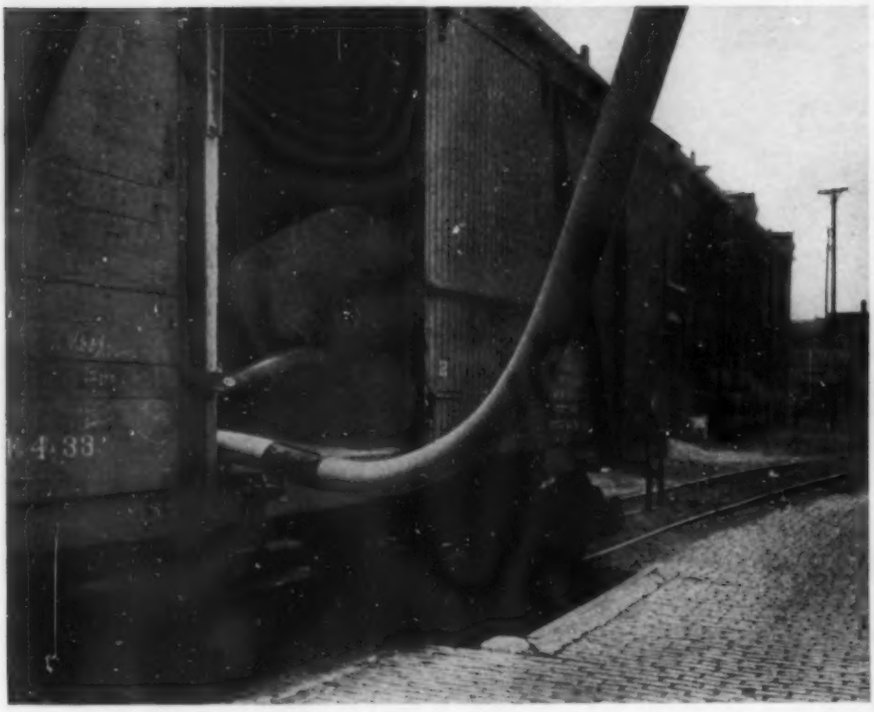

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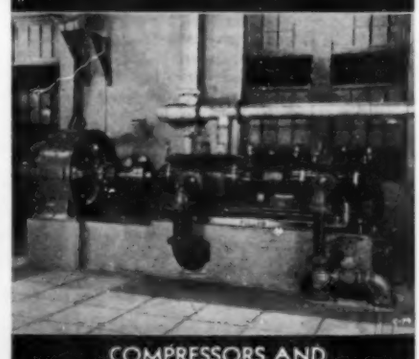

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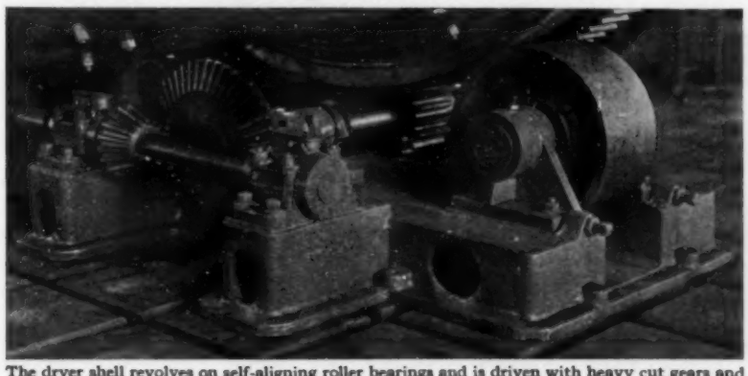

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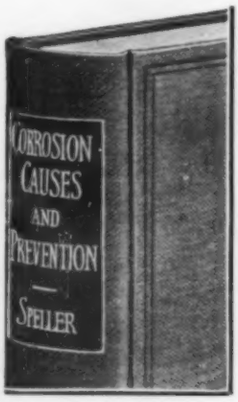
What the engineer wants to know about corrosion



Here is a book that brings you a systematic, authoritative presentation of the available information on the corrosion problem from the standpoint of the engineer, whether he be engaged in the metallurgical field, in chemical engineering, in power plant work, in structural engineering or with the problems of transporting oil, gas, or water. The book combines in one volume a thorough treatment of the theory of corrosion and a detailed description of methods of preventing corrosion. It deals particularly with the ferrous metals.

CORROSION

Causes and Prevention: An Engineering Problem

by **FRANK N. SPELLER**

Director, Department of Metallurgy and Research, National Tube Company. (Subsidiary of U. S. Steel Corporation)

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- *—corrosion; the kinds there are and the factors of their nature and occurrence*
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Features of the second edition

The abundant new experimental data, from many sources, that have become available since the first edition was published have been reviewed, and all of the important developments with respect both to the influence of various factors and the means of prevention are covered in this edition. Especially significant among this material is that on problems that vary with the metal and its environment, methods of testing, new knowledge of soil corrosion and protective coatings for use underground, and practical application of preventive measures to iron and steel, together with the economics of this subject.

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CHEM & MET

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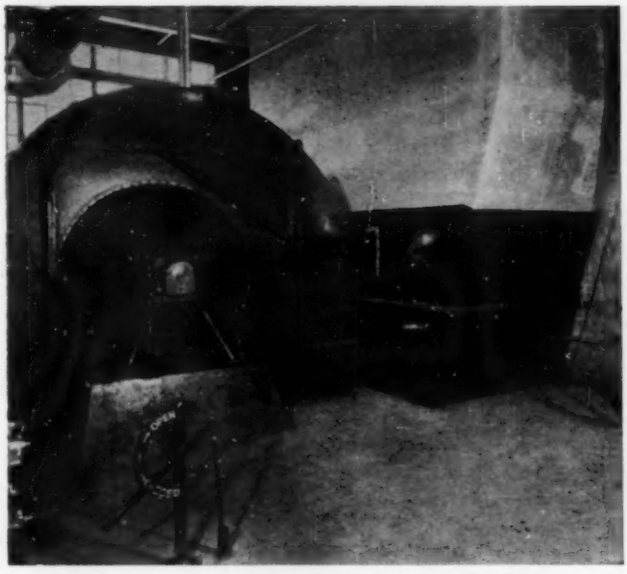

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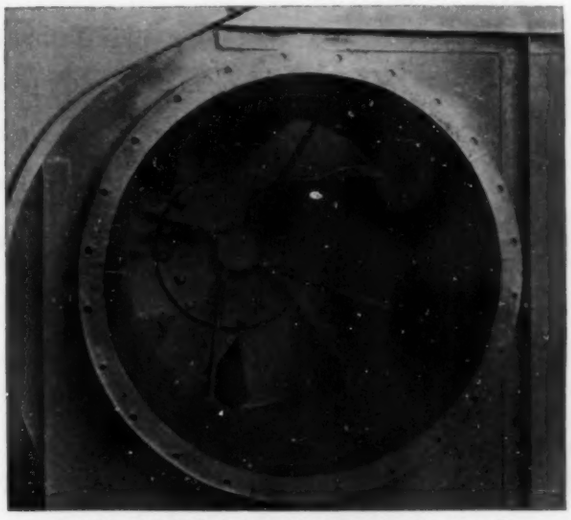

Interior of Buffalo Rubber Lined Fan showing smooth, soft rubber coating, which makes handling corrosive fumes easy.

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32 NEW
Chem & Met Flow Sheets!

We have a limited supply of a 16-page reprint containing 32 New Flow Sheets. These were originally printed as part and parcel of our past November issue, but due to the demand for this material we have put this section back on press. In this same folder you will also find over 40 new processes outlined in detail.

Supplement your present flow sheet files with this new group. The price is but 35c., clip the coupon today!

Send me ..... copies of your 16-page Flow Sheet Reprint by return mail.

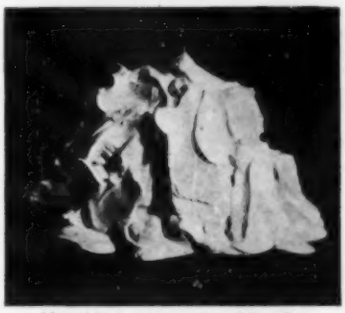
Name .....

Address .....

City .....State.....

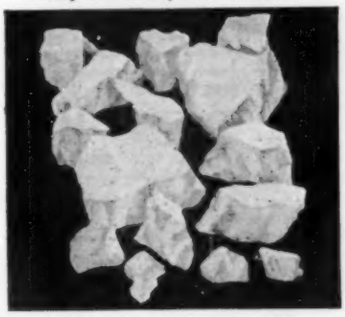
NEW SPEED in DRYING

Above—New form of handling material in even-size little sticks.



Not this lumpy mass, with relatively small exposed surface—

Not slabs of filter cake, with relatively small exposed surface—



Not broken filter cake, with large lumps among small.

AERO-FORM

The New PROCTOR Dryer for Filtered or Settled Materials

Lithopone, for example, is being dried by the New Proctor AERO-FORM Dryer in as little as 40 minutes, where formerly it required 24 hours. Other materials that took 2 to 6 hours by older methods are being dried in 30 to 50 minutes. This amazing new speed in drying is due to the *new form* in which the material is dried . . . tiny sticks, all the same size, shape and body structure . . . made this way by an ingenious first-step of AERO-FORM drying, and carried on a wire-screen conveyor in a loosely-piled bed, through which efficiently circulated air has free play as shown above. Each tiny stick has six surfaces exposed, and the moisture in the center travels less than a quarter inch to any surface for evaporation. Obviously, this gives a tremendously multiplied drying surface, and radically reduced drying time, compared with any of the older forms of material shown on the left.

Faster drying is but one of many revolutionary advantages of AERO-FORM drying for a wide variety of materials which are presented in a profusely illustrated 26-page descriptive book we'll gladly send you free on request. Write

PROCTOR & SCHWARTZ • INC
PHILADELPHIA

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

UNDISPLAYED—RATE PER WORD:

Positions Wanted (full or part-time salaried employment only), 5 cents a word, minimum $1.00 an insertion, payable in advance. *(See ¶ on Box Numbers.)*

Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.

Proposals, 50 cents a line an insertion.

INFORMATION:

Box Numbers in care of our New York, Chicago and San Francisco offices count 10 words additional in undisplayed ads.

Discount of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

1 inch $6.00
3 to 3 inches..... 5.75 an inch
4 to 7 inches..... 5.50 an inch

Other spaces and contract rates on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page. C.&M.

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL 10 A. M. THE 5TH OF THE MONTH FOR THE ISSUE OUT THE 15TH OF THE MONTH

POSITIONS WANTED

ADVERTISING and sales promotion manager with many years of active advertising experience in different branches of the industrial field, will consider proposition of joining an industrial organization aiming to get its full share of the business in the offing, and familiar with the important part which advertising and sales promotion methods play in reaching sales objectives. Details by addressing PW-314, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

ANALYTICAL CHEMIST—15 years' experience, analysis of metals, ores, fuel, pigments, potash, phosphates, cyanides, waxes, soaps, electroplating and ceramic materials. PW-274, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

CHEMICAL ENGINEER: wide experience in the process industries, desires change to growing concern. Capable of supervising chemical, labor, and budget control of manufacture of organic chemicals. Good record of invention, originality, and cost reduction. PW-316, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

CHEMICAL ENGINEER with four years' work in smelting and refining non-ferrous metals, also nitrogen filtration and fertilizers. Design, development and operation (3 years). PW-317, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

ELECTRICIAN, I.C.S. graduate, thoroughly experienced lithopone and colorplants. Wishes change. PW-312, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

EXPERIENCED construction and operating chemical engineer for heavy chemical plant. Lead burning a specialty. PW-319, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

GAS ANALYST—Seven years' experience in research and industry. Thoroughly qualified in every phase and mode of gas analysis, including Podbielniak Fractionation. Now in charge of gas laboratory. Available in one month. PW-320, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

METALLURGICAL CHEMIST having five years' experience in gold and copper and six years in automobile constituents. PW-318, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

EMPLOYMENT SERVICE

HIGH GRADE MEN, contact employers through our confidential and individual methods. Established 20 years. The National Business Bourse, 20 W. Jackson Blvd., Chicago.

POSITION VACANT

Vice-President, Charge of Sales

Corporation, engaged in practical sales research in field of sewage treatment, reservoirs and industrial on chemical and heat resisting products, offers man, with knowledge of ferrous and non-ferrous alloys, a real opportunity.

P-321, Chemical & Metallurgical Engineering
330 West 42nd Street, New York City

WANTED

By Large Chemical Company, Sales Manager familiar with markets for Mono-, Di-, and Tri-Calcium Phosphate and other chemicals. Give experience, references, personal qualifications, present salary, in first letter. Applications considered confidential. Our own sales organization knows of this ad. P-322, Chemical & Metallurgical Engineering, 520 No. Michigan Ave., Chicago, Ill.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 25 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details. R. W. Bixby, Inc., 260 Delward Bldg., Buffalo, N. Y. (C. M. E.)

AMERICAN ENGINEERS SERVICE, Park Row Building, New York. Distinctive employment proposals: Metallurgical, Ceramic, Oil, Plastic industries, Alloys, Smelters, Dyes, Paper, Eastern-Western, Southern regions.

BUSINESS OPPORTUNITIES

New Products Wanted

Large chemical manufacturing corporation with widely diversified activities invites information concerning products which might form additions to its present lines, or furnish the basis for new lines. Contacts will be arranged with those supplying sufficient information in their initial letter to make possible at least a rough appraisal of the attractiveness of the proposal. BO-285, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

FOR SALE

Chemical Periodicals

For sales, back copies of such as Chemical and Metallurgical Engineering, Chemistry and Industry, Journal Chemical Society, Industrial Engineering, Chemistry. H. Login & Son, Inc., 29 East 21st St., New York.

SELLING OPPORTUNITIES
AVAILABLE—WANTED
Selling Agencies—Sales Executives
Salesmen—Additional Lines

AVAILABLE

CHEMICAL equipment salesman wanted by a manufacturer of a line of corrosion-resisting equipment for the chemical and allied industries. Applicant should have a chemical engineering degree, or considerable plant experience. Should be under thirty years of age and have two or more years of actual experience in selling mechanical equipment. SW-314, Chemical and Metallurgical Engineering, 330 West 42d Street, New York City.

Don't forget the
Box Number

WHEN answering the classified advertisements in this magazine, don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

PEBBLE MILLS

2 and 4 jar Laboratory Mills, 35 gallon one piece lining, 24"x36", 30"x33", 36"x42", 42"x42", practically new.

BALL MILLS

3' Marcy 3'x5' Patterson
4½', 5', 6', 8' Hardinge.
Silex Lined Tube Mills 5½'x18'—4½'x15'—4½'x12'.

Radojet Vacuum Pumps and Condensers.
Swenson double effect Evaporator.
5'x12' Drum Dryer a complete unit.
Glens Falls Sulphur Burner.
Shriver Filter Presses, wood, iron, and bronze, 24", 30" and 36".
Sweetland Filter 23—15" leaves.

Rebuilt—condition guaranteed.

EDW. W. LAWLER, Inc.
Durham Ave., & L.V.R.R., Metuchen, N. J.

SPECIAL OFFERING!

(1) **Werner & Pfleiderer Mixer,** size 17-21, type X-Vacuum-Xanthator. 500 gallon full capacity, 220 gallon working capacity, fully jacketed, inverted poppet discharge valves. Practically new.
(1) **Werner & Pfleiderer Mixer,** 20 gallon capacity.
(1) **Shriver Filter Press,** 24"x24", 24-1" chambers, closed delivery, as good as new.
(1) Abbe No. 2 Eureka Porcelain Mill; 15 gallon.
(5) **Tumbling Barrels,** 60" dia. x 36" face, copper cylinders.
Vacuum Shelf Dryers, No. 11 and No. 27.

Only a Partial List.

R. H. GLANDER
724 Lake Street, Newark, N. J.
Tel.: Humboldt 2-3852

WANTED

USED INDUSTRIAL DIAMONDS

PLATINUM SCRAP
IN ANY FORM

We pay highest market price, make prompt returns and hold goods for your approval.

I. MILLER, Smelter and Refiner
304 Colonial Arcade, Cleveland, Ohio

WANTED

EVAPORATOR

Quadruple effect vertical tube all iron about 2000 square feet per effect.

W-313 Chem. & Met. Engineering
520 No. Michigan Ave., Chicago, Illinois

WANTED TO BUY

laboratory desks and tables, also general laboratory equipment. All must be in good condition. Submit offers with full description to

W-311, Chem. & Met. Engr.
330 West 42d St., New York City

Merry Christmas Happy New Year

This Christmas, we know, will be merrier than ever . . . because for the first time in years men are looking forward with confidence to the steady upward trend of business in the months to come, and our wish for your prosperity in 1936 is a practical one—for we can take from your mind all worries about needed equipment—about its condition, its delivery, its price. Then, let us say again, as we have said for the past seventeen years—A Merry Christmas—A Happy New Year.

Buy with Confidence . . . "CONSOLIDATED"

AUTOCLAVES

1—150-gal. jacketed, Agitated.
1—600-gal. jacketed, Agitated.

DRYERS—TRUCK AND TRAY

1—Gordon Tray Dryer, 20 shelves, 240 sq.ft.
1—Proctor & Schwartz 3-truck Dryer, 810 sq.ft.
1—Hurricane 14-truck Dryer, 3150 sq.ft.
1—42-truck Hurricane Dryer, 9450 sq.ft. tray surface, complete.

DRYERS—VACUUM SHELF

10—Devine No. 3, No. 5, No. 9, No. 11, No. 12, No. 13, No. 27, No. 32; 1—Buffalo 15 shelves, 60"x80"; 1—Buffalo J-20.

DRYERS—DRUM

1—18"x48" Double Atmospheric.
1—4'x28" Buffalo Atmospheric.
1—4'x8' Buffalo Atmospheric.
1—4'x9' Devine Double Drum Atmospheric.
1—4'x12' Lakeshore Double Drum Atmospheric.
1—5'x12' Buffalo Atmospheric.

DRYERS—ROTARY VACUUM

2—Devine 3'x25'.
1—Stokes 30"x8'.
1—Devine 5'x25'.
3—Devine 5'x33'.
1—Stokes 17"x3'
1—Stokes 4'x8'
3—Devine 3'x12'.
1—Devine 3'x15'.

DRYERS—ROTARY VACUUM DRUM

2—Buffalo 5'x12', 1 bronze drum, 1 iron drum, complete with receivers, pumps, and piping.

DRYERS—ROTARY

8—Direct Heat, 3x25, 4x20, 5x26, 5x36, 6x40, 8'x60', 8' 8"x85'.

EVAPORATORS

1—Swenson Aluminum Triple Effect Evaporator, 250 sq.ft. per effect.
1—Devine Copper Single Effect Evaporator, tin lined.
1—Badger Double Effect Evaporator, 2200 sq.ft. per effect.
1—Oates Triple Effect, All Copper, 4870 sq.ft.

CENTRIFUGALS—BELTED AND MOTOR DRIVEN

5—60" Tolhurst, late type.
4—48" Tolhurst.
2—48" Fletcher.
3—40" Tolhurst.
4—26" Tolhurst, rubber covered.
20—30" to 36" Tolhurst, American Laundry, Troy, etc.

SPECIAL CENTRIFUGAL EXTRACTORS

Brand new Tolhurst 60" bronze basket extractors, copper lined casings. Texrope drives with 2-speed, 3 hp. G. E. Motors and push-button Starters.

SPECIALS

3—J. P. Devine 5x33' Rotary Vacuum Dryers, complete.
1—Lummus Copper 500-gal. Jacketed Vacuum Pan.
2—Duriron 750-gal. Jacketed Kettles.
4—Aluminum 500-gal. closed jacketed agitated Kettles.
1—Swenson aluminum triple-effect Evaporator, 250 sq.ft. per effect.
2—100-ton York Refrigerating Units, vertical type, each directly connected to 150 hp. synchronous motors, 3/60/440 volts.
1—200 hp. B. & W. Boiler, 200-lb. working pressure, ASME.
3—70 hp. Coatesville horizontal Boilers, 150-lb., unused.
2—300-gal. All bronze Jacketed Mixers, double sigma bladed, tilting type.
2—Buffalo 5x12' Rotary Vacuum Drum Dryers, one iron drum, one bronze drum, complete with receivers, pumps, and piping.
1—U. S. No. 3 Rotary Smelting Furnace, with rotating motor.
1—24x72" Magnetic Pulley, Mag. Mfg. Co., with m.g. set.
1—42-truck Hurricane Dryer, 9450 sq.ft. tray surface, complete.
1—Feine Festoon Dryer with Feine Rotary Vacuum Filter, etc.
1—8' 8"x85' Ruggles-Coles Class A-18 Direct Heat Rotary Dryer.
2—3-Roll Raymond High Side Mills.
1—12 ft. Gayco Air Separator.

FILTER PRESSES—IRON AND WOOD, OPEN AND CLOSED DELIVERY, RECESSED, PLATE AND FRAME

4—Shriver, 42"x42".
6—Shriver, Johnson 30"x30".
2—Shriver, 24"x24".
5—Shriver, Johnson Sperry 18"x18".
1—Johnson 24"x24", lead.
8—Sperry 10"x10".
4—Shriver, 7"x7", 1—Aluminum.

SWEETLAND FILTERS

1—No. 12; 1—No. 10; 1—No. 8; 3—No. 7; 1—No. 5; 2—No. 2, Lab.

OLIVER FILTERS

1—3x2; 2—3x4.
1—6x4, Wood Staves.
1—6'x6'—Steel.
3—8'x8'—Steel.
1—8'x9'—Steel.

W. & P. MIXERS

1—Lab. 3-gallon.
1—Size 11, jacketed, 9 gal.
1—Size 14, jacketed 50 gal.
2—Size 14, unjacketed, 50 gal.
5—Size 15, jacketed, 100 gal.
1—Size 16, jacketed, 150 gal.
1—Size 17, unjacketed, 200 gal.
1—Size 18, jacketed, 500 gal.
2—Size 21, jacketed, 625 gal.
15—Size 30, jacketed, 2650 gal.

MIXERS

6—1000-gal. Horizontal Jacketed.
2—800-gal. Horizontal Jacketed.
1—500-gal. Day Jacketed, Jumbo.
30—Dough Mixers, ½ bbl. to 6 bbl.
4—60-gal. and 100-gal. Day Imperial.
22—Dry Powder Mixers, 50 lb. to 4,000 lb., complete, with and without sifters.

SULPHUR BURNERS

6—Glens Falls 3'x8', 4'x16', 4'x20'.

VACUUM PANS

5—Copper, 75 gallons to 500 gallons.
1—6' Copper Vacuum Pan.
1—7' Kilby Calandria Pan, copper coils.

DISTILLING UNITS

12—72", 60", 54", 48", 36", 24", 14", complete with Dephlegmators, Condensers and Still Pots.

KETTLES—All Types and Sizes

300 in stock—open top, closed, jacketed and unjacketed, with and without agitators, with and without copper and steel coils, vertical and horizontal.
Made of Cast Iron, Steel, Copper, Aluminum—Glass Lined, Lead Lined, Duriron and Monel Metal.
Capacities from 25 gals. to 20,000 gals.

VACUUM PUMPS—All Sizes and Types

CRUSHING AND GRINDING MACHINERY

Send for your copy of latest bulletin listing Raymond Mills, Schutz-O'Neill, Sturtevant, Fuller-Lehigh, Ball and Pebble Mills, Hardinge Mills, Jaw and Gyratory Crushers, Tube Mills, Dryers and Kilns.

Send for the latest issue of the Consolidated News listing our complete stock of Filter Presses, Dryers, Kettles, Evaporators, Pulverizers, Crushers, Mixers, Vibratory Screens, Boilers, Pumps, etc.

REMEMBER—WE BUY YOUR IDLE EQUIPMENT FOR CASH, SINGLE ITEMS OR COMPLETE PLANTS.

CONSOLIDATED PRODUCTS CO., Inc.

Members of "National Association of Used Machinery and Equipment Dealers."

15 PARK ROW, NEW YORK CITY Shops: 335 Doremus Ave., NEWARK, N. J.

TEL., BARCLAY 7-0600 *"Every machine in your plant is a used machine"* CABLE ADDRESS: EQUIPMENT

BUY WITH CONFIDENCE
"CONSOLIDATED"

BIG SAVINGS

Used Chemical and Industrial Machinery

Beverage Equipment

Gin Stills; Rectifying Columns; Enameled and Copper Receivers; Aluminum Filters and Pumps; Stills and Blending Tanks.

Mixers and Kettles

3—5 gal. Colton Mixers.
5—8 gal. W. & P. Mixers.
30—Dopp Kettles, jacketed, 60 to 300 gals.
9—Copper, 5 to 800 gals.
70—Aluminum, 15 to 100 gals.; jacketed.

Filters

1—42" Sq. Shriver C. I. Press.
3—24" Sq. Filter Presses, C. I.
2—18" Sq. Filter Presses; C. I.
3—12" Sq. Shriver Filter Presses.
2—14" Aluminum Filter Presses.

Dryers

2—Devine Rotary Vacuum Dryers, 5x33-ft., complete with condensers and pumps.
2—Devine Vacuum; 13 shelves.

Miscellaneous

8—Steam Boilers.
8—Devine Vacuum Pumps; 4x6; 10x10.
Air Compressors; LARGE STOCK.
Horizontal Mixers; many sizes.
Centrifugal Extractors, 24" to 40".
Storage Tanks, up to 10,000 gals.
6—Pebble Mills; assorted.
2—24-in. Cogwell Mills.
1—Gruendler, XXXX, belted, new.
1—Mashek Hammer Mill.
1—Moore Pulverizer Mill.

Machinery & Equipment Co., Inc.

Office, Warehouse and Yards
429-437 Frelinghuysen Ave., Newark, N. J.
Tel. Bigelow 3-5050 and 5051.

With

Best Compliments

of the Season

STEIN-BRILL CORPORATION

183 VARICK ST., NEW YORK CITY

SPECIAL OFFERINGS

1—Buffalo inclined tube triple effect Evaporator—550 sq.ft.
1—Buffalo 5'x30' Rotary Vacuum Dryer.
1—Shriver 36x36" 40 plate recessed Filter Press—open delivery.
1—Sweetland Filter with 24-30" dia. copper leaves on 3" centers.
2—Pfaudler 9000-gal. Tanks (New).
8—Stokes & Smith double powder Fillers.
1—0000 Raymond Pulverizer.
2—1000-gal. glass lined Vacuum Pans.
2—No. 450 Kelly Filters.
3—50-gal. W. & P. Mixers.

Send us your inquiries for guaranteed rebuilt process equipment. What equipment have you for sale?

LOEB EQUIPMENT SUPPLY COMPANY
618 West Lake Street, Chicago, Ill.

FOR SALE

100 and 300 gal. Pfaudler Jkt. Kettles.
No. 146 Stokes High Vacuum Pump.
12" Aluminum Filter Press.
18" Shriver Filter Press, closed delivery.
75 gal. Glass Lined Mixing Kettle.
No. 2 Robinson Horiz. Jkt. Mixer.
4½x16 and 6x22 Hardinge Mills.
17x10 Chicago Pneumatic Air Compressor.
8x6 Devine Vacuum Pump.
30 and 150 gal. Aluminum Jkt. Kettles.
60, 100, 160, 200, 300, and 600 gal. Glass Lined Tanks.

Only a Partial List. Send Us Your Inquiries.

ROBERT P. KEHOE MACHINERY COMPANY
One East 42nd St., N. Y.

3—Symons 48" Vertical Disc Crushers in excellent condition.
Cost new over $5,000.00 each, our price $500.00
Also all other equipment from Chemical Plant.

HARRIS WRECKING CO.
1900 Washington Blvd., Baltimore, Md.

FOR SALE

MAGNETIC SEPARATOR

Dings Type B, "High Intensity," Serial No. 2662, tight and loose pulley, 2 K.W. D.C. Generator and Rheostat, good condition, priced right.

Johnson & Hoehler, Inc., Lansdowne, Penna.

F M C

Send Us Your Inquiry

RECONDITIONED MACHINERY

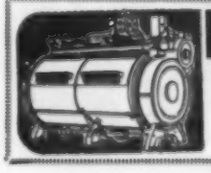
PRICED FOR QUICK DISPOSAL!

1—Devine 3x8' Double Drum Atmospheric Dryer.
1—Devine 4x9' Single Drum Atmospheric Dryer.
2—Devine No. 11 Vac. Chamber Dryers, 17 shelves.
2—375 Gallon Copper Jacketed Kettles.
4—Aluminum Kettles 200 gallons.
5—Stokes B, BB, D, DD Tablet Machines.
20—Copper Jacketed Kettles, 5 to 125 gals.
1—Tolhurst 48" Copper Basket Centrifugal, belt driven.
3—W. & P. Jacketed Double Arm Mixers, 20, 100, 2600 gal.
3—Day and Ross Double Arm Mixers—5 to 30 gals. capacity.
5—Williams, Jay-Bee, Mead No. 2 Raymond 0000 Pulverizers.
2—Hardinge Mills—54x16" and 60x22".
4—Pfaudler 300 gallon enamelled Percolators or tanks.
4—Day and Gedge-Gray 50 to 2000 lbs. Sifters and Mixers.
2—DeLaval belt driven Benzene Separators.

A large stock of Filters, Fillers, Labellers, Grinders, Mixers, Tablet machines and Presses and other equipment for processing industries available for inspection at our show-room. Our unqualified guaranty that equipment offered and shipped is mechanically perfect may be depended upon.
Write, wire or telephone your need.

COMPLETE PLANTS BOUGHT and SOLD

FIRST MACHINERY CORP.
419 LAFAYETTE STREET
New York City • GRamercy 7-6622



CENTRIFUGAL EXTRACTORS

Make money NOW—by ordering machines that are immediately available—instead of waiting weeks or months for delivery. We offer guaranteed washing—drying machinery rebuilt like new. Complete line of extractors from 18" to 60" available for immediate delivery. Write for list.

WILLIAMS LAUNDRY MACHINERY COMPANY
'Phone: Circle 7-1393 Dept. C 1780 BROADWAY, NEW YORK CITY

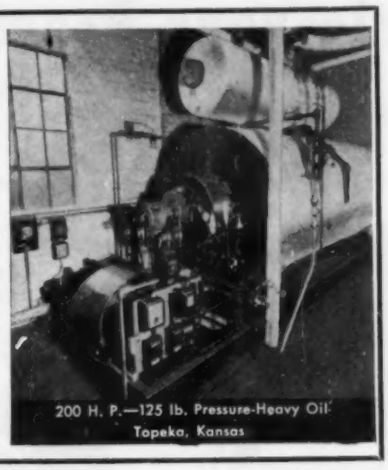
LOW COST STEAM *with* OIL

COMPACT • NO STACK • FAST STEAMING

Oilbilt

STEAM GENERATING PLANTS
"The Modern Plant"

Four pass, down draft, controlled air for complete combustion. Designed for burning oil. No expensive stack or breeching. Quickly installed. Small space required. Sizes 20-500 H.P. Write today for catalog and prices.



200 H. P.—125 lb. Pressure-Heavy Oil
Topeka, Kansas

CLEAVER-BROOKS COMPANY, Dept. A, 129 W. Wells St., Milwaukee, Wis.
167-M

• WRITE TODAY • **A number of foresighted manufacturers are spending money in these pages to tell you about their products and service. These men are justifying their faith in advertising. Pull along with them by finding out what they can do to help you. Advertised products are dependable products.**

SEARCHLIGHT SECTION

Continued from opposite page

DELIVERING THE GOODS IS A QUESTION OF..WHAT?

SEE PAGES 24-25

Equipment For Sale

Because of Change of Process, Manufacturer Offers the Following Equipment For Sale:

2—Devine Steam Jacketed Vacuum Impregnating Tanks 48" I.D. x 36" Straight Depth Complete with Valves and Fittings.
1—Size 11-III-BB Universal Baker Perkins Mixer, C. St. Sigma Blades, Gear Assembly, Guards, Tilting Lever, Locking Device, Guards and Accesoriess, with Link Belt Silent 5 hp. Chain Drive.
2—Gehnrich Gas Ovens 28x31x46.
1—Matthews 14" Belt Conveyor with Cleats for service between two floors with Reversible Motor.
4—Oliver Motor Driven Acid Pumps, 2 hp., 220-440 V., AC, 3 phase, 1800 r.p.m., with Ball Bearing Motors, together with a quantity of Acid Proof Fittings.
1—Rectangular Jacketed Iron Tank 32x47x36.
1—American Blower Corp. No. 35E, Inlet 12½" sq., outlet 14" dia.
2—Devine Surface Condensers.
1—No. 3¾ Greenerd Arbor Press.

Located at Brooklyn, N. Y. and May Be Inspected at Any Time, Box 156.

REALSERVICE
15 East 40th St., New York

TO HELP YOU

SELL WHAT YOU NO LONGER NEED

"Searchlight" Advertising

Is your Process Time Too long?

Would another 50°F. higher help you?... Or maybe 100°F.?... Do your processes require temperatures beyond the range of high pressure steam ... Are your products too delicate to trust to direct firing?... Must the rate of heat input be closely controlled?

With the Merrill Process System of Industrial Heating you *can* have accurate control over heat input, product temperature, heat generation and the temperature of the heating medium. Merrill Process delivers heat to kettles, tanks, stills, impregnators, deodorizers, pipe lines, etc., at any required rate—maintains any required temperature up to 550°F.—by means of Hot Oil Circulation. There is no corrosion—as when steam is the heating medium. No erosion. No variables. No guesswork. Write for complete information about the economy and efficiency of Merrill Process.

PARKS-CRAMER CO.

Engineers and Contractors

1102 Old South Building · Boston, Mass.

MERRILL PROCESS

Low Pressure
High Temperature

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DRACCO FILTERS solve a nuisance and make a PROFIT

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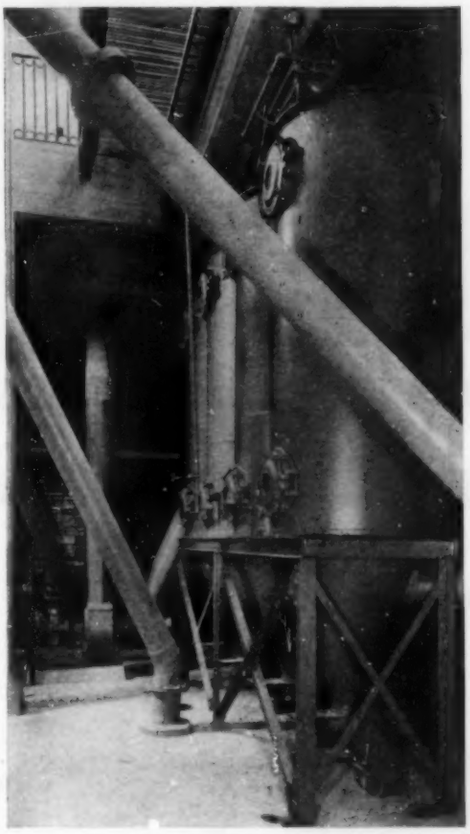

One of the outstanding reasons for the success of DRACCO Filters is the wealth of Dust Control experience that we apply in solving the many engineering problems that must be overcome to obtain an efficient system. Our Engineers study the problem from every angle and then DESIGN a unit with the view of getting the greatest EFFICIENCY at the lowest COST. It may pay to have us check your plant.

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G-333

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CHEMICAL & METALLURGICAL ENGINEERING

The BATTLE AGAINST CORROSION GOES ON

The Chemical Show again forcibly emphasized that the greatest enemy of Chemical Production—is corrosion.

In this battle, Pfaudler Chemical Equipment occupies the front line trenches. Perhaps you've heard that Pfaudler Glass-Lined Steel is the only material resistant to all acids, (except HF) in any concentration or at any temperature. This is no idle statement of a hope, but a fact that has been proved year after year. The savings this equipment makes in replacements alone run into a huge figure every year.

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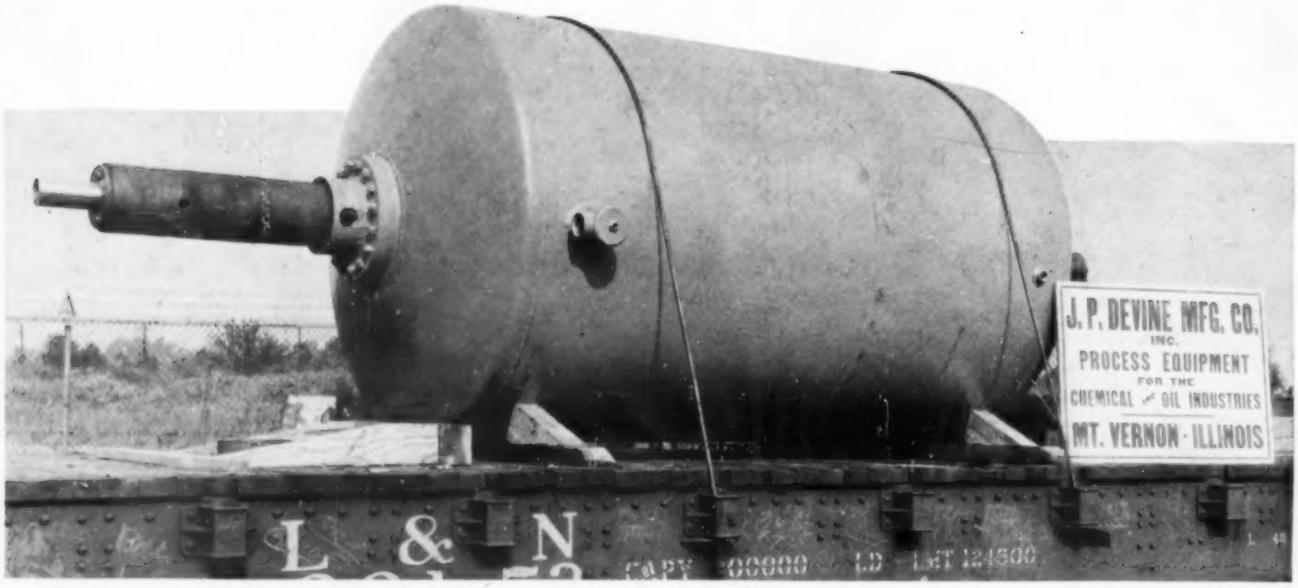
PFAUDLER

GLASS-LINED STEEL EQUIPMENT



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- Coolers
- Crystallizers
- Digesters and Extractors
- Distillation Equipment
- Dryers:
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  - Vacuum Drum
  - Vacuum Pan
  - Vacuum Rotary
  - Single and Double Drum
  - Revolving
  - Atmospheric
- Evaporators
- Flakers
- Fractionating Columns
- Fumigators, Vacuum
- Heat Exchangers
- Impregnators
- Jacketed Kettles
- Jacketed Pipe, Valves, and Fittings
- Kettles
- Solvent Stills and Recovery Apparatus
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- Vulcanizers

DEVINE again demonstrates its Ability and Experience...

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Monel Metal, Everdur, nickel, nickel-clad, stainless steel, and stainless-clad steel vessels fabricated by DEVINE are each handled correctly and behind each job stands the DEVINE guarantee—assuring the user that only first-grade materials and the best of workmanship were incorporated in the job.

Send your inquiries to DEVINE for attractive prices, quick deliveries, and expert workmanship on corrosion-resisting vessels.

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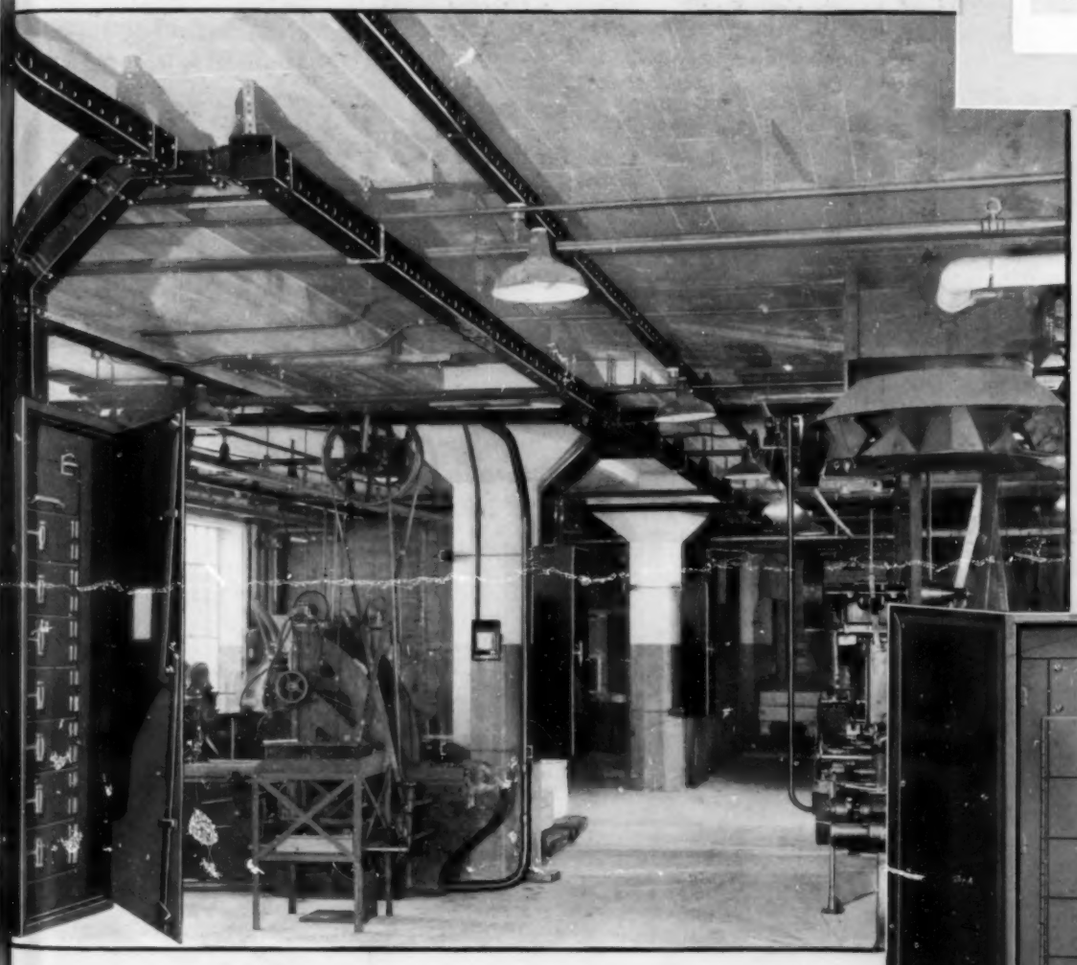
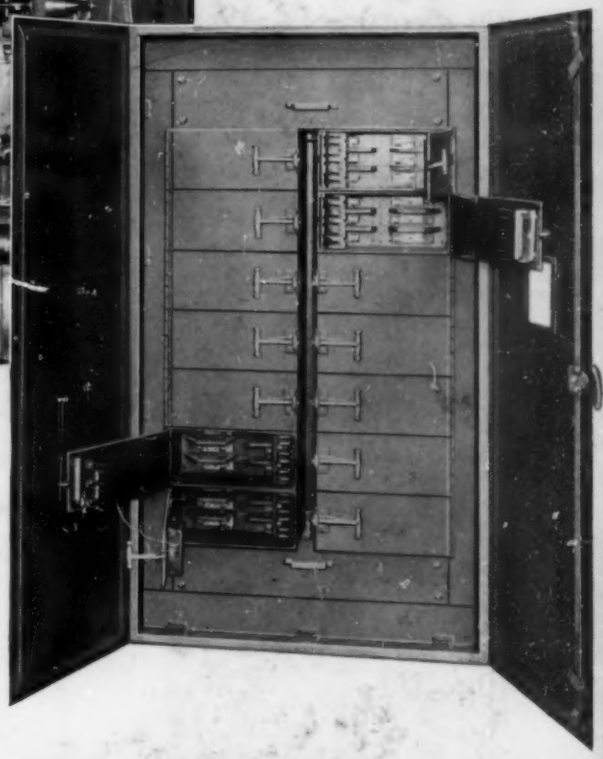


Square D Saflex Panels are excellent in design and appearance. They are designed for both power and light distribution.



■ The industrial plant equipped with SQUARE-Duct and Saflex Panelboards has no problem when changing production schedules requires a relocation of machines.

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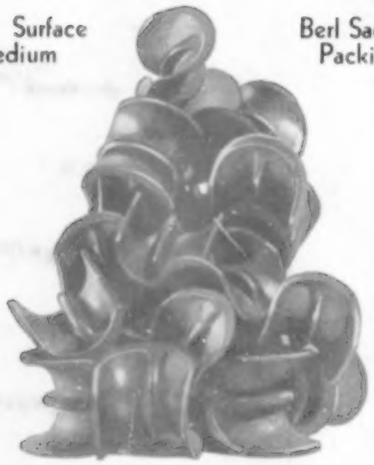

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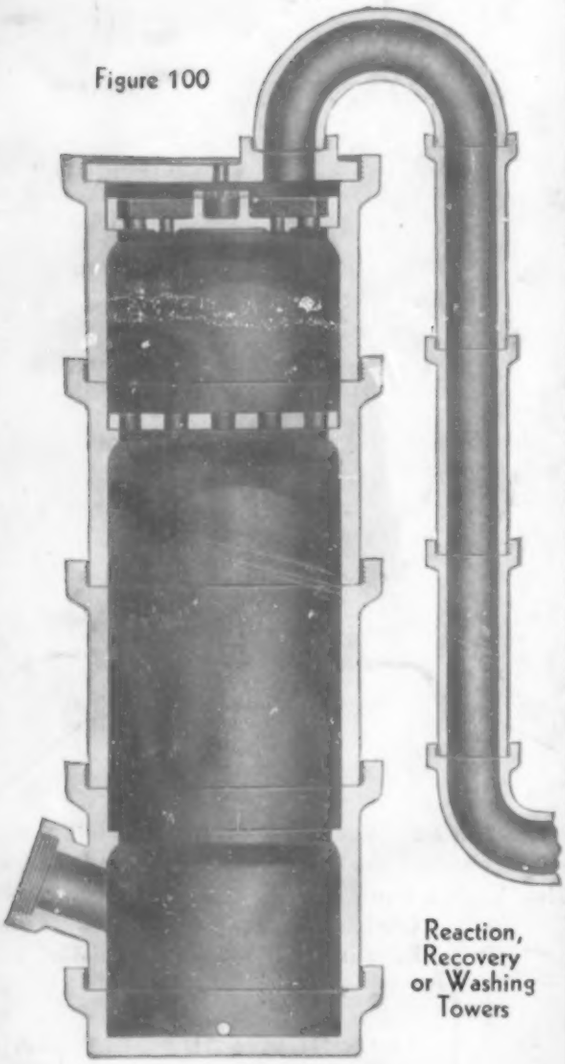

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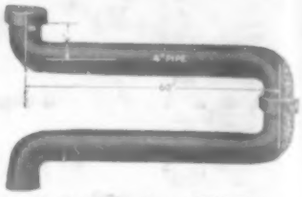

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